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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE

INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Hidden Treasure.

The breaking up of battleships and other men-of-war is at the present time an extremely important industry. Unfortunately the people controlling these enterprises, with some outstanding exceptions, employ little or no metallurgical help. They possess a considerable amount of empirical knowledge as to the value of the various steels and alloys which go to build up and furnish men-of-war. There is one phase of this work which has seldom been tackled to the best advantage of all concerned, and that is that each portion of the ship has conformed with various Admiralty specifications which almost invariably include chemical limitations. In the files of the large armament manufacturers there exist the fullest details of the composition of each separate component, which can be presumed to comply with specifications imposed. They do not lose their identity during assembly and metallurgically we see no reason why these should not become available for both the ship-breaker and the eventual buyer, even if it involved a small charge. After all, this information can always be had by either party by a fair expenditure of time and money. For remelting purposes, the fact that the material has complied with the specification may be sufficient, but one can easily visualise cases where material at one end of a limit will meet a set of re-fabricating conditions entirely different from its original purpose, whereas at the other end difficulties may be encountered. Obviously, it is ridiculous that when complete analyses of the component pieces of thousands of tons of material are available that no effort should be made to render them accessible to the ultimate buyer.

Similar conditions are gradually being built up in the grey iron foundries. There are hundreds of Diesel engine cylinders and liners which will in time be returned to the cupola for remelting.

Now it so happens that amongst the best makes will be found both high and low sulphur irons. When these return as scrap to the foundries some hazy notions often exist as to the origin and probable composition, but a wise foundryman would not dare to incorporate any large quantity in a mixture for a special job without previously analysing, but if an analysis was available the scrap would be rendered so much more valuable.

Surely, when a ship-owner buys material he has a right to the analysis, which has a market value when the material becomes scrap. No doubt many superficially-sound objections could be put forward by prominent concerns, but we feel sure that they would not stand investigation. As to the practicability of launching such a scheme, a continuous effort by scrap users to impress upon their suppliers to furnish analysis wherever possible—not a certificate of origin nor yet one of a binding character—would in time arouse the interest of the dealers in this question. They would be well advised to comply wherever possible, because nine out of ten firms of repute would be prepared to pay more for scrap which could be identified as being domestic.

We are prepared to say that somewhere there exists the full history of every armour plate, propeller, shaft, large gun, and many other items incorporated in the British Navy, which could be definitely identified, to the undoubted benefit of all concerned. At the moment, the determination of the character of the various materials in a ship is often effected by the "file test." Surely such a method should be replaced by one based on a schedule of composition conserved from its early fabrication.

Nickeliferous Cast Iron.*

By Paul D. Merica.

Although the use of nickel as an alloying element in steel was developed rather early, having its inception as far back as 1885, the development of its use in cast iron has been very slow and is of comparatively recent origin. This has been due partly, of course, to the fact that cast iron is essentially a cheap product, and it was not thought that it could bear the cost of nickel addition, but it has been due also to the fact that little has been known generally among foundrymen about its effect on iron.

To-day cast iron is emancipating itself somewhat from its accepted rôle of poor cousin to steel, and much more care and attention, and what is more significant, expense, is being devoted to its manufacture than ever before. It is not considered uneconomical to-day, for example, to use the electric furnace for the production of iron for certain special purposes. In recent years also, many foundries have considered the institution of chemical and physical control methods, a not unwarranted expense, although they were considered highly extravagant some years ago. It is not strange, therefore, that there is to-day renewed interest in the development of cast iron alloyed with nickel and other elements.

Development of this subject has not so far proceeded to the point where all possible applications of nickel in cast iron can be foreseen. The International Nickel Company is studying the matter, however, in its laboratories, and it is hoped that through these investigations a little more light may ultimately be shed on the matter. It is obviously a complicated problem; the effect of nickel on iron depends, of course, upon the presence and amounts of other elements, upon the form of the carbon, etc.; it is far from simple. Therein lies the explanation perhaps of the fact that those few investigators who have hitherto looked into it have made quite contradictory reports.

Effect of Nickel on Cast Iron.

There are available the reports on this subject by several investigators who have agreed in some statements and disagreed in others. However, from a consideration of their results, as well as of the experience of the International Nickel Company and of others who have been engaged practically in the production of nickel cast iron the following statements seem to be warranted:—

The presence of nickel in cast iron causes increased graphitic carbon formation; *i.e.*, nickel tends, as does silicon, to "grey" the iron. This effect is quite definite but fairly mild; 1 per cent. of nickel being equal perhaps roughly to from ¼ to 1 per cent. of silicon in this respect.

The nickel does not form carbides, but dissolves in the ferrite of the iron. If the composition is such that combined carbon is present in the castings, this will be fine in structure in the presence of from 1 to 5 per cent. nickel, and more resembling sorbite than pearlite, and in consequence harder.

It will be seen, therefore, that nickel exercises two effects of quite opposite nature; by lowering the combined carbon it softens the iron, but by "sorbitising" the pearlite matrix of the iron it hardens it. Which of these will prevail depends largely, it is thought, on the amount of combined carbon. If this is low in the composition of iron under consideration—*i.e.*, the iron is soft and "open"—the nickel will soften it still further; if it is high—from 0.3 to 0.8 per cent.—the hardening effect will predominate, as, in fact, it generally does in practice.

What has just been said explains partly the disagreement of different investigators in commenting on the effect of nickel on the mechanical properties of cast iron, and indicates also the difficulty of making general statements concerning it. What effect on mechanical properties is gained by the addition of nickel will depend upon the type of iron used—the latter may be hardened or softened, strengthened or weakened.

Grades of grey iron carrying from 0.50 to 0.85 per cent. of combined carbon will in general be hardened, strengthened and toughened by the addition of from 1 to 5 per cent. of nickel. Increases of from 15 to 40 per cent. in hardness and in bending or compressive strength are thus obtained. Particularly in thin sections is the use of nickel often beneficial in that good values of hardness may be obtained without incurring the risk of obtaining chilled or mottled iron or "hard spots." The hardness obtained in grey iron by means of nickel additions is not due to an increase in the amount of carbide present—as it is when obtained by lowering the silicon content—with consequent attendant machining difficulties, but is due to the superior and finer form of the pearlite or carbide in the presence of nickel.

The effect of 4 per cent. of nickel was gained by making two sets of two plats each of iron, similar except for the presence of the nickel.

It is interesting to note that the ⅛-in. bars of one melt were mottled and brittle, yet not as hard as the perfectly grey bars of a similar melt containing nickel.

The effect of the addition of from 1 to 5 per cent. of nickel on the fluidity and the shrinkage of cast iron appears to be so slight as to be inappreciable. The addition of nickel, however, appears to produce finer grain castings, particularly in thin sections. The resistance to corrosion of nickel bearing cast iron is somewhat superior to that of similar iron without nickel, but probably not sufficient to warrant its use generally to increase corrosion resistance. On the other hand, the resistance to oxidation at high temperatures is increased by the addition of nickel, and some efforts have been made to utilise this feature in a practical manner.

When nickel is used in connection with chromium the combined effect of the two elements depends on their relative amounts, but is generally in the direction of hardening and strengthening the iron and increasing its chilling power. Dr. Moldenke has made a very exhaustive study of the effect of one particular combination of nickel and chromium; namely, that of Mayari pig-iron.

Method of Making Nickel Addition.

Nickel may be added either in the cupola or in the ladle. For the former purpose nickel shot may be used, but it should be very coarse, probably not under ¾ in. A preferable form is that of 25-lb. blocks, which, of course, will not fall through the charge as shot will do. Amounts of nickel up to 5 per cent. may actually be added in the ladle and readily absorbed. In this case, finer shot is desirable, to pass a ¼- to ½-in. screen—and this should be fed gradually into the stream of hot metal from the cupola spout.

More recently the International Nickel Company has developed a grade of nickel shot for this purpose having a much reduced melting point and which in consequence dissolves much more quickly in the ladle metal.

If an electric furnace is used the nickel may be included in the charge in the usual manner—using either shot or blocks.

APPLICATION OF NICKEL CAST IRON.

Rolls and Pipe Balls.

Probably the earliest use of nickel in cast iron was for the production of rolls and pipe balls.

Nickel and nickel-chromium cast iron have won for themselves a definite place in the steel industry and the development of their use is still progressing. The rolls used in a mill can be classified as either sand-cast iron, chilled cast iron, steel or "alloy." The latter term almost invariably refers to a nickel or nickel-chromium cast iron, a large amount of which are sold under the trade name of "Adamite." The range of analysis of such rolls will approximate silicon 1.00 to 2.00, manganese 0.40 to 0.75, carbon 1.50 to 3.50, chromium 0.75 to 1.50, nickel 0.50 to 1.50. Such rolls are used for roughing, stranding and finishing, in

* An abridgment of an article which appeared in the August issue of "The Canadian Foundryman."

which they regularly produce many times the tonnage of the ordinary roll before redressing, but they are pre-eminently fitted by their hard surface, toughness and resistance to wear to the first two uses. A chilled roll is found more often in the finishing passes.

Other accessories used in the manufacture of steel are regularly made from nickel or nickel-chromium mixes. These include rolling mill guides, which perform the functions of leading the steel into the proper pass of the mill; bending dies in a pipe mill which bend the skelp into positron to be welded and pipe balls which support the skelp during the welding operation, a typical analysis for these purposes being silicon 1.50 to 2.50, manganese 0.40 to 0.70, carbon 2.75 to 3.25, nickel 1.00 to 2.50, and chromium 0.75 to 1.25 per cent., and should be given a good anneal prior to use. In making seamless tubing similar uses are found for these materials in the piercing and drawing plugs, while a considerable tonnage goes into forging industry as hammer blocks. For all these purposes the situation demands a material which has a great resistance to wear together with strength.

Automobile Cylinders and Pistons.

The use of nickel cast iron for cylinder blocks and pistons of automobile engines was developed by the Cadillac Motor Car Company in an effort to improve the quality of these castings and to secure greater length of service from them.

The idea of using nickel in the cylinders was due in the first place to J. J. Wilson, of the Cadillac Company, and its development has been further promoted by H. B. Swan, superintendent of its foundries, through whose courtesy the author is able to present a brief description of their experience and practice.

For the cylinders an iron is used containing from 1.75 to 1.90 per cent. silicon and from 1.50 to 2.00 per cent. nickel. Without the nickel addition the Brinell hardness would average from 130 to 150; with addition of nickel the hardness can be increased to 175 to 200. This increase may, of course, be accomplished by other means, but with increased difficulty in machining. Inasmuch as these difficulties are eliminated by the use of nickel, the experience of the Cadillac Company has been that it is more economical to secure this hardness by the use of nickel than by other means.

From service tests of cylinders they have found that with the lower hardness a wear of from 0.0015 in. to 0.002 in. was obtained in 20,000 to 25,000 miles, and the cylinders would need regrinding. With a Brinell hardness of 175-200, however, the cylinders showed a wear of only from 0.00075 in. to 0.001 in., and did not need regrinding. This Company credits this decreased wear not only to the hardness of the iron but also to the fine grain and high lustre finish which can be produced with addition of nickel. It has been found that the nickel cast-iron cylinders at 200 Brinell hardness machine as easily as the nickel-free ones at 150 Brinell.

For pistons this Company uses a 2.50 to 2.75 per cent. silicon iron with about 1.5 per cent. of nickel. Without the nickel the section of ¼ in. is so thin that the iron would tend even with this high silicon content to be hard and mottled. The addition of nickel prevents the formation of any white iron, but produces a fine grain readily machineable iron.

In some recent tests in co-operation with another motor car manufacturer, cylinders were cast with the regular mixture to which various amounts of nickel were added. The Brinell hardness values on these cylinders indicate nicely the effect of nickel:—

	Brinell Hardness.
Normal mixture	141
With 0.89 per cent. nickel ...	157
1.36 per cent. nickel ...	170
1.89 per cent. nickel ...	195

Resistance Grids.

The Westinghouse Electric and Manufacturing Company uses a 5 per cent. nickel cast iron in the production of electrical resistance grids. The nickel raises the electrical resistance and improves the mechanical properties and toughness of the castings which are necessarily of thin sections. The nickel addition eliminates the tendency for the formation of hard or chilled white iron, and thus strengthens and toughens the casting. These castings carry about 2.50 per cent. silicon and from 4 to 5 per cent. nickel.

Chemical Industry.

For certain special purposes nickel cast iron has been in use to a limited extent in the chemical industry. Because of the increased resistance to corrosion by alkalis a 3 per cent. nickel cast iron has been used for melting pots in the naphthol industry as well as for valves for special purposes.

Moulds.

The addition of 3 to 4 per cent. of nickel decreases the rate of oxidation of cast iron at higher temperatures, and in consequence such iron has been used to a limited extent in the production of moulds for copper castings as well as in the glass industry for bottle glass moulds. Similarly such iron has been used for zinc-base die-casting nozzles.

Nickel Chrome Cast Iron.

In combination with chromium, nickel is added in amounts of from:—0.5 to 1.5 per cent. nickel and 0.5 to 1 per cent. chromium, to white iron used for crushing rolls and machinery, grinding plates, sand blast nozzles.

H. T. Force recommends the use of a 0.10 to 0.25 per cent. chromium 0.10 to 0.20 per cent. nickel cast iron for chilled car wheels.

Conclusion.

Although it is evident that the knowledge of nickel cast iron as well as the commercial use of it are to-day still limited, such compositions appear to offer real advantages for certain special purposes, and consideration should be given them more generally by foundrymen. The use of nickel alone appears to be justified when maximum hardness and fine grain are required for readily machineable grey iron—and particularly in thin sections or whenever the casting has both thin and thick sections.

The nickel chromium cast iron, on the other hand, appears to offer promise chiefly for chilled iron where maximum hardness is required, but where the iron does not need to be machineable.

Catalogues Received.

Steel Conveyor Bands.—We have received from Steel Belt Conveyors, Limited, of Norwich Union Chambers, Birmingham, a single blotter leaf, giving a few details of their use.

Cast-iron Pipes.—The monthly stock for September list issued by the Staveley Coal & Iron Company, Limited, of Chesterfield, is now available.

Research Work.—Vickers, Limited, of Vickers House, Broadway, Westminster, London, S.W.1, have prepared a leaflet describing the exhibits in the Vickers' Research Room in the Palace of Engineering, British Empire Exhibition.

Worm Reduction Gears.—We have received from Crofts (Engineers), Limited, Bradford, a 16-page booklet illustrating and describing worm reduction gears. Tables of powers and sizes of standard types are included, and examples of various types are illustrated.

Stainless and Other Steels.—Thos. Firth & Sons, Limited, of Norfolk Works, Sheffield, have produced a 24-page souvenir booklet, which after describing the history of the firm, illustrates by means of a series of sepia pictures the manufacture of both wrought and cast stainless steel. Then the making of large castings and forgings and the manufacture of files are similarly dealt with.

Foundry Statistics.

In July, France made 636,168 metric tons of pig-iron (as compared with 638,873 in June). It included 142,633 tons of foundry iron. The output of steel castings was 13,448 metric tons. The imports of pig-iron were 5,052 metric tons, and that of castings 399 tons. Amongst the exports were 7,535 tons of castings.

XUM

Company News.

J. Brockhouse & Company, Limited.—Dividend, 7½ per cent.

Butterley Company, Limited.—Interim dividend, 4d. per share, free of tax.

Lennox Foundry, Limited.—Net profit, £1,194, reducing debit balance to £11,396.

Liptak Furnace Arches, Limited, 38, Victoria Street, S.W.1.—Capital £5,000 in £1 shares.

Clarke, Chapman & Company, Limited.—Interim dividend, 2½ per cent., less tax, on ordinary shares.

Hurst, Nelson & Company, Limited.—Ordinary dividend, 2s. per share and bonus 1s. per share, free of tax.

Sheffield Forge and Rolling Mills Company, Limited.—Loss for year, £12,911, increasing total deficiency to £26,420.

Bothel Lime and Limestone Company, Limited.—Capital £3,000. Solicitor: J. Johnson, Aspatria, Cumberland.

G. Rushbrooke (Smithfield), Limited, 73, Charterhouse Street, E.C.1.—Capital £30,000 in £1 shares. Ironfounders.

Cammell, Laird & Cmpany, Limited.—Interim dividend, 2½ per cent., less tax, on 5 per cent. cumulative preference shares.

Stewarts & Lloyds, Limited.—Dividends for half-year to June 30 last: 6 per cent. on preference and 10 per cent. on preferred ordinary.

Heath Fowler, Limited.—Capital £5,000. Hardware manufacturers and merchants. Directors: E. Vaughan, E. H. Fowler and M. S. Vaughan.

Ibbotson Bros. & Company, Limited.—Profit, £11,897; brought forward, £68,060; available, £76,146; dividend, 5 per cent., tax free; carry forward, £71,476.

J. F. Parker, Limited, 24, Davenport Road, Altrincham.—Capital £3,000 in £1 shares. Iron merchants. Directors: J. F. Parker, Mrs. E. Parker, F. Parker and Elsie Parker.

John Spencer & Sons, Limited.—After payment of debenture interest and including debit balance brought forward (£27,628), there is debit balance of £90,968. No preference dividend.

Nobel Industries, Limited.—Net profit, £1,032,489; brought forward, £509,018; dividend for year on ordinary shares, 8 per cent.; special investment reserve account, £100,000; carried forward, £650,131.

Haywood's N.C.A. Metal, Limited.—Capital £1,100 in 1,000 £1 ordinary and 2,000 1s. management. Engineers, founders, etc. Solicitors: P. S. Solomon Archer and Company, 110, Cannon Street, E.C.4.

Fitt Bros. & Davies (1924), Limited, 17, Wind Street, Swansea.—Capital £6,000 in £1 shares. Electrical and mechanical engineers, iron and brass founders, etc. Secretary (pro tem.): D. E. Joseph.

A. E. Ward & Company (Birmingham), Limited, 15, Arch, Livery Street, Birmingham.—Capital £1,000 in £1 shares. Factors and importers of and dealers in new and second-hand machinery, machine tools, etc.

Silica Gel, Limited.—Capital £315,500 in 300,000 8 per cent. cumulative preference shares of £1 and 310,000 ordinary of 1s., to acquire processes for effecting the separation of or recovery of gases, etc. Directors: C. W. Miller, T. E. Thirlaway and J. Reah, Mosley Street, Newcastle-on-Tyne.

A British Moulding Sands Research.

The Council of the British Cast Iron Research Association has appointed Mr. J. G. A. Skerl, M.Sc., to take charge of an important investigation on moulding sands. Mr. Skerl has for nearly three years been research assistant to Professor P. G. H. Boswell, of the University of Liverpool, who has done so much work on moulding sands. The new work will be conducted in the Refractories Department of the University of Sheffield (Mr. W. J. Rees, F.I.C.), and in the foundries of members of the Association. The investigations contemplated are of such a character that the results may be made of immediate and practical utility to the ironfounding industry.

THE workpeople of Smith, Patterson & Company, Limited, Pioneer Foundry, Blaydon-on-Tyne, spent last Saturday at the British Empire Exhibition at Wembley.

"THE IRON AGE" reports three fatal accidents from electrical vibrators used in shaking sand from foundry moulds during a period of six weeks in the Milwaukee district. A pamphlet is to be issued in the near future outlining the safety measures to be taken in handling such machines.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"Jobbing Foundry Quotations."

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In connection with your recent leader on this subject, I came across a Paper given before the Jobbing Founders' Association, Philadelphia, in 1908, by James S. Stirling, and later published in the June, 1908, issue of THE FOUNDRY TRADE JOURNAL, outlining what was described as a "Uniform Cost System for Jobbing Founders." This, while going into greater detail than would be considered necessary by some founders in this country, did not cover certain points outlined in my Paper (see page 247). But it is significant that after so many years no similar attempt—the Paper and the system were the result of a joint attempt by the above Association to prevent unsound competition between themselves through defective estimating methods—has yet been made in this country.

Elaborate Papers and articles have been given, but there are still a majority of founders who consider these to be too involved or too confusing for their own use. While secrecy as to actual figures may be necessary, there is no disadvantage in comparing methods with the object of obtaining a standard system to prevent unsound competition over here.

Chance conversation shows a wide difference in charges, figures for metal varying from 6s. to 8s. 6d. per cwt. It is evident that comparison of the two figures cannot be made unless it is known what the figures include, though it would appear one was rather low and the other much too high.

I heard a complaint by one foundryman that a firm had secured a contract for certain castings at 10s. 6d. per cwt., and a statement was made that the metal-cost would prevent economic production at such a figure. The castings in question were cylindrical columns, and it is not difficult for practical foundrymen to see that a column may be the same diameter and otherwise similar in every particular except thickness, say ⅝ in. thick and the other 1¼ in. thick, without entailing extra work for the moulder. Thus the heavier column may work out at 10s. 6d. while the other might exceed that figure, there being very little more than half the weight for the same moulding.

Some firms do work on a reasonable basis in estimating costs, but I am aware that others avoid too much detail and employ rule-of-thumb—a price of so much per cwt. being considered suitable for names of types of castings so vague as pulleys, brackets, columns, small work, etc., without any other qualification. I am also aware that there are certain castings which could be made at present with profit at 8s. 6d. per cwt., and even less, and others that could not be made at less than ten times that figure.

Your leader was to the point, and I am surprised that nobody came along before in support, though, no doubt, those capable of giving weight to your arguments have either not the liberty or are unwilling to believe in the existence, except in isolated cases, of such crude methods. Meanwhile the buyer, who did not hesitate to take his orders abroad when it suited his purpose, even while decrying foreign competition, is reaping the harvest: and even if odd firms prefer to pass his orders at low figures on to competitors, there is always one ready to accept.

I trust you will excuse such lengthy remarks, but I feel that some support was necessary to the leader to which I referred.—Yours, etc.,

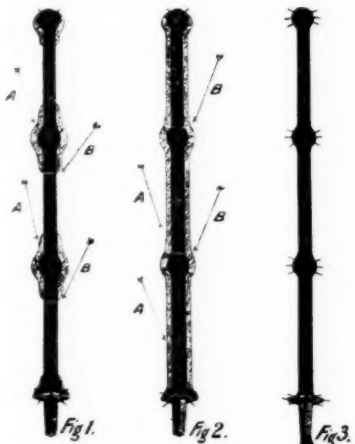
"ECOSSAIS."

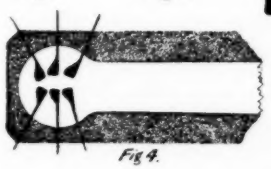
Trade Agreement between Canada and Holland.—A Reuter's cable from Ottawa states that a Trade Agreement between Canada and Holland for mutual extension of the most-favoured nation treatment was formally signed by the Canadian Ministers for Colonisation and Trade and the Dutch Consul-General on September 5. By the agreement Canada secures the lowest Dutch tariff for bituminous coal and other main items of export to Holland. In return Holland secures Canada's intermediate tariff for her main items of export to Canada. The Treaty is to become effective upon ratification by both Parliaments.

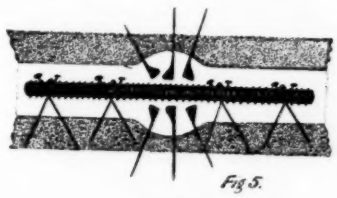
Some Steel Foundry Experiences.

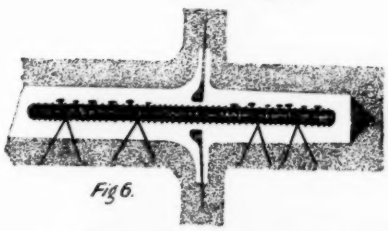
By H. V. Fell.

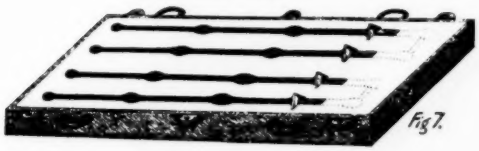
The object of this article is to describe a few steel castings which have been made by the writer, and to indicate their defects and the means by which they were overcome.

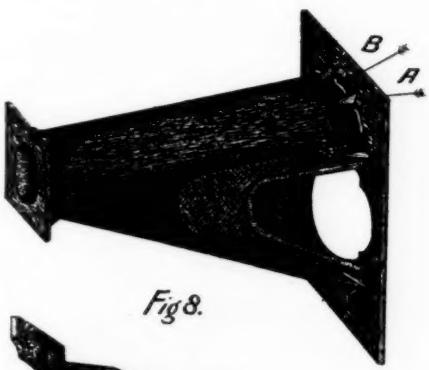


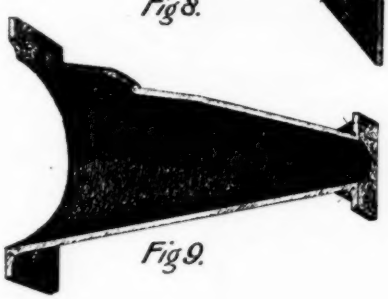


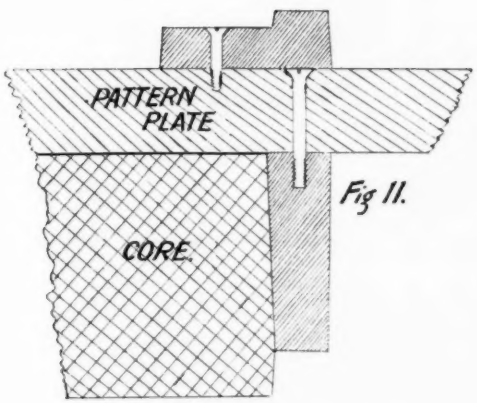


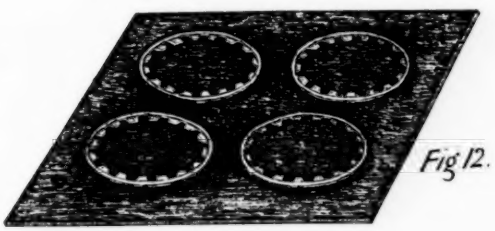


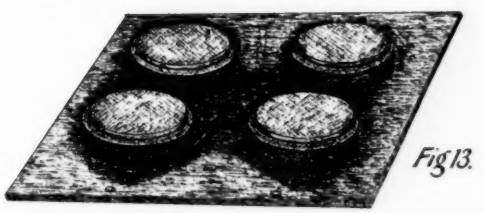












Figs. 1, 2 and 3 show sketches of a stanchion casting, for which the number required was quite substantial, and owing to the present poor state of trade they could not be refused, as would no doubt often have been the case under normal conditions, owing to the great risk they involve. As the majority of foundrymen know, such articles are generally manufactured by the drop forging process, therefore the writer knew beforehand that there would be difficulties in getting sound castings, but determined to overcome them.

It was decided to make a strong oddside and

mould them four in a box, as shown in Fig. 7. This first box was made by bracketing the stanchion and chilling at the thick section by means of inserting horse-shoe nails, as shown at A, Fig. 1.

These were cast in pairs in a sloping position, at an angle of approximately 25 deg., and although the castings were eased as rapidly as possible the

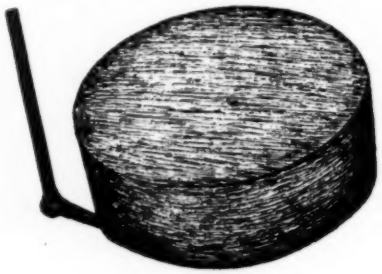


Fig 14.

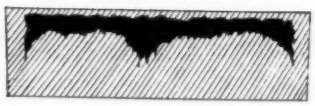


Fig 15.

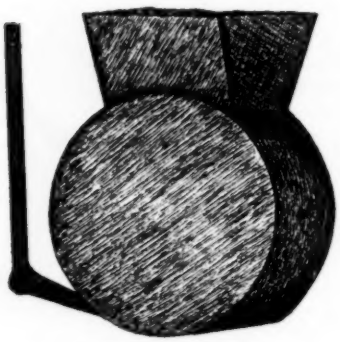


Fig 16.

result was that fractures occurred at the end of the brackets, as shown at B, Fig. 1.

It was then assumed that if the brackets were extended to the full length of the casting, as at A, Fig. 2, it would remedy this defect. However, the result was practically the same, only the fractures appeared close to the bulb, as at B, Fig. 2.

It was now decided to give a further chilling effect at the thick section, and to eliminate the brackets altogether. This chilling effect was brought about by inserting suitable pieces of steel at those places. These were supported and held in position by driving nails in the mould crosswise, as shown in Figs. 5 and 6.

Care was taken to see that these chills were free from rust and dirt, and to have them nicked or ridges cut in them, as shown in the sketch, so as to allow them to become homogeneous.

These were now cast singly, after which the upright portion of the runner was broken off with easing bars while in a semi-molten state. This enabled the top box to be removed within a few minutes after casting, thus further reducing the easing operations.

The result was successful, and in addition brought about a reduction in the cost of production, by eliminating the removal of the brackets, as was necessary in the first operation.

These stanchions, after annealing, gave during the subsequent tests made on test-pieces obtained from breaking up some of the castings, quite satisfactory results.

However, the writer warns foundrymen that when attempting this method, great care must be taken in calculating the size of the chills to be used, and not overdo the chilling effect, otherwise he will obtain heterogeneous castings.

Pedestal Castings.

Fig. 8 show the sketch of a pedestal casting, and Fig. 9 the same casting cross sectioned. As in general steel practice, brackets were placed in the position as shown at A, and again, although the core was made with practically a frame of sand, filled with cinders, to facilitate the easing operations, fractures appeared, as shown at B, Fig. 8, between the brackets. However, the same remedy was satisfactorily applied as in the case of the stanchions, but with the retention of the brackets.

Brake Drum Castings.

Fig. 10 shows the sketch of a brake drum casting. These were machine moulded, the patterns being split and fixed on the machine plate as shown in Figs. 11, 12 and 13.

As these sketches show, this work was run in pairs, and without head allowances. The centres were cored out, to enable them to be rammed up lightly, and thereby help the subsequent easing operations. It will be noticed that this work was cast with the lugs down. This method gave the best result after a series of experiments. These castings have to be machined all over. The closing operations were carried out by locating the cores in the top part, after which the drag was placed in position. They were then clamped together and the whole turned over for the casting operations.

A Solid Disc Casting.

Fig. 14 shows the general appearance of a 14 in. × 4½ in. solid disc. The order was for 4-off and the castings had to be machined all over. After obtaining a satisfactory result with the brake drums the proprietor, an engineer, and no doubt looking at the problem of their moulding from an engineering point of view, that is to eliminate the necessity of removing the head allowance, he insisted on these discs being moulded and cast on the same principle, although the foundry advised him as to the uselessness of such procedure. The result was the loss of castings by being defective, as shown at Fig. 15, after which the work was remade without interference by the method indicated in Fig. 16, which gave satisfactory results.

Replacing a Pulley Casting.

Fig. 17 shows the appearance of a broken pulley casting, which had to be replaced very urgently, therefore this mould had to be made by using the old casting for the pattern, with the aid of a strickle (A, Fig. 19), and the usual sweeping up tackle, and a corebox. In carrying out the operations, a spindle and cross were set up in the desired position in the usual way, after which the drag was placed over, located and rammed up to the desired height. This finished, the annular chill B was placed in position, this chill having a centre hole to the size of the core C, so as to form the

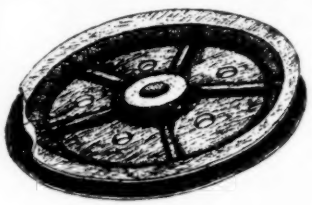


Fig 17.

Fig 18.

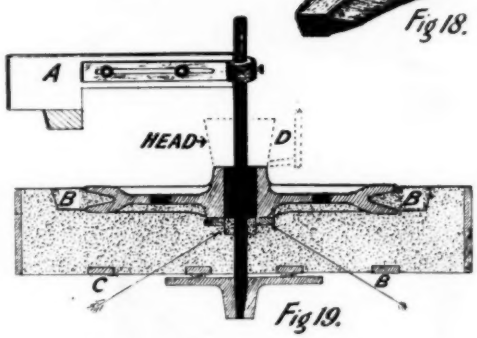


Fig 19.

print. The pattern was then bedded on the sand and centred from the spindle, as shown in Fig. 19, after which the job was proceeded with in the usual way until the whole was rammed up, with the head allowance and runner as shown at D, Fig. 19. All that then remained was to strike out the print E for the segment cores, Fig. 18, care being taken to give the necessary contraction allowance. The pattern was then withdrawn from the sand, finished off and completed.

Some Experiments on the Influence of Casting Temperature and Mass on the Physical Properties of Admiralty Gunmetal.*

BY FRANCIS W. ROWE, M.Sc. (Huddersfield).

A great deal of work has been done previously on the particular zinc-bronze known as Admiralty gunmetal. Much of the published data is, unfortunately, distinctly contradictory, and the following experiments are recorded to stimulate further discussion in order to clear up contradictory data.

They have been selected from a large number as being typical results obtained in everyday works practice, and were made under ordinary works conditions, without any special precautions to ensure exceptional purity of the metal or abnormal test results.

Method of Moulding the Test-Bars.

Three boxes of test-bars were moulded. Each box contained three test-bars moulded horizontally in green sand. The bars were 12 in. × ½ in. × ½ in., 12 in. × 1 in. × 1 in., and 12 in. × 2 in. × 2 in.

The bars were run with an 1½-in. diameter down runner terminating in a splay to each bar. The actual ingate to the ½-in. square bar was ½ in. square; that to the 1-in. square bar was 1 in. × ½ in., and to the 2-in. square bar 1 in. × 1 in.

A riser was placed on the bars exactly similar to the runner. The distance from the top of the runner basin to the mould joint was 7½ in.

Preparation of the Metal.

The metal used for casting these bars was one of the ordinary mixings used in the foundry where the bars were made. It consisted of equal quantities of new metal (88:10:2.25), remelted borings and scrap (heads and runners).

At the time the experiments were made the foundry was using B.S. copper, Mersey Brand, Williams-Harvey Refined "Lamb and Flag" block tin, and "B.V.S." brand spelter. Thus the new metal forming part of the charge was made from these. The scrap was all domestic, and the remelted borings had the necessary corrections added to bring them up to standard composition. 150 lb. of metal was melted in a 200-lb. Morgan graphite crucible in a round coke-fired pit furnace. The ingot copper, ingot borings, and scrap were charged into a pre-heated crucible and covered with charcoal. The total time the metal was in the furnace was 85 minutes. After the crucible was withdrawn the zinc was added and stirred in, and then the block tin. The temperature was then taken and found to be 1,240 deg. C. The temperature was taken with a platinum—platinum-rhodium couple encased in a ½-in. dia. silica sheath and connected to an indicator of the pivoted type. The outfit had previously been checked with the works standard instruments.

The three boxes were poured with the metal at the following temperatures (the temperature recorded being that of the metal immediately prior to the pouring):—No. 1, 1,200; No. 2, 1,150; and No. 3, 1,100 deg. C. The bars were allowed to cool normally in the sand overnight.

Analysis of Test-Bars.

Carefully checked determinations were made on drillings from the runner of No. 1 box and the riser of No. 3 box. As these only differed within the limits of analytical error, the average was:—Copper, 87.54; tin, 10.16; lead, 0.28; iron, 0.03; zinc, 1.88; phosphorus, 0.007; arsenic, 0.041; and antimony, 0.013 per cent.

Preparation of Test-Pieces.

The test-bars were cut up in the following manner:—

½-*in. Square Bars.* — An 8-in. length was machined into a 0.33-in. dia. tensile test-piece. A 3-in. length was machined into a standard B.E.S.A. Izod test-piece. A ½-in. length from the middle was reserved for micro-investigation.

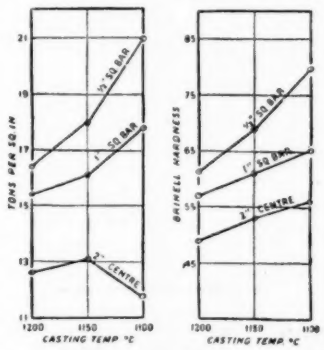


FIG. 1.—GRAPHS SHOWING VARIATION IN MAXIMUM LOAD AND BRINELL HARDNESS, WITH CASTING TEMPERATURE AND SIZE OF BAR.

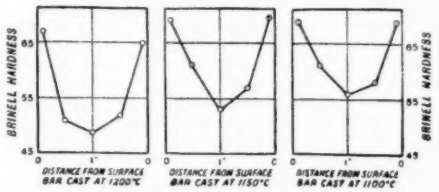

BRINELL HARDNESS
DISTANCE FROM SURFACE BAR CAST AT 1200°C
DISTANCE FROM SURFACE BAR CAST AT 1150°C
DISTANCE FROM SURFACE BAR CAST AT 1100°C
BRINELL HARDNESS

FIG. 2.—GRAPHS SHOWING VARIATION FROM OUTSIDE TO CENTRE OF THE 2-IN. SQUARE BARS.

1-*in. Square Bars.*—An 8-in. length was machined into a 0.75-in. dia. tensile test-piece. A 3-in. length was machined into a B.E.S.A. Izod test-piece. The test-pieces were located in the centre of the bar. A ½-in. piece from the middle was reserved for micro-examination.

2-*in. Square Bars.*—These were treated rather differently. A piece ⅞-in. sq. × 12-in. was machined from the centre of the bars by milling in such a manner as to leave 4½-in. square bars from the corners. Thus two tensile bars and two Izod bars were obtained from each bar

TABLE I.

Mark.	Description.	Casting Temperature °C.	Yield point. Tons per sq. in.	Maximum load. Tons per sq.in	Elongation on 2 in. Per cent.	Brinell Hardness.		Izod. Ft.-lb.
11	½ in. square bar	1200	8.7	16.4	18.0	61		5
12	½ ,, ,, ...	1150	9.7	18.0	18.5	69		6
13	½ ,, ,, ...	1100	11.6	21.0	22.0	80		6
21	1 ,, ,, ...	1200	8.9	15.4	18.0	57		11
22	1 ,, ,, ...	1150	9.0	16.1	18.0	61		10
23	1 ,, ,, ...	1100	9.3	17.8	20.5	65		10
						In-side.	Out-side.	
3101	2 in. square bar outside ..	1200	10.1	16.0	22.0	51	67	10
3102	2 ,, ,, ,, ..	1200	9.6	15.2	18.0	52	65	12
3201	2 ,, ,, ,, ..	1150	10.2	17.0	21.5	61	69	9
3202	2 ,, ,, ,, ..	1150	9.8	16.6	26.0	57	70	15
3301	2 ,, ,, ,, ..	1100	9.3	16.0	21.0	61	69	14
3302	2 ,, ,, ,, ..	1100	9.7	16.9	30.0	58	69	18
31C	2 in. square bar centre ..	1200	7.9	12.6	19.0	49		3
32C	2 ,, ,, ,, ..	1150	8.3	13.1	14.0	53		6
33C	2 ,, ,, ,, ..	1100	8.1	11.8	13.0	56		4

*Abstract of a Paper read before the Autumn Meeting of the Institute of Metals.

representing the outside portion, and one tensile bar and one Izod bar representing the centre. These tensile bars were 0.33 and 0.65 in. dia.

Brinell hardness tests in all cases were made with a 500-kg. load and 10-mm. ball on the broken halves of the Izod pieces. The Brinell figure in each case is the average of five impressions.

The results of these physical tests are tabulated in Table I and graphically in Figs. 1 and 2. It was noticed in the case of the outside pieces from the 2-in. square bars that there was a very noticeable difference between the Brinell hardness as shown on that surface which represented the outside of the bar and that which represented a plane ½ in. from the outside. Accordingly, two series of Brinell impressions on these bars are recorded.

Discussion of Results.

It will be seen from these figures that the best results were obtained from the smallest sectioned bar cast at the lowest casting temperature. The tensile and elongation figures are slightly lower in the 1-in. square bar, but the casting temperature of 1,100 deg. C. still gives the best results. The physical tests on the test-pieces from the 2-in. square bars are interesting, and illustrate what may be expected in the centre of very heavy castings.

The rapid fall in hardness from the outside to the inside of these 2-in bars is also interesting, and in all probability density results would show a similar drop.

A Method for Measuring Internal Stress in Brass Tubes.*

By ROBERT J. ANDERSON, B.S., and EVERETT G. FAHLMAN, B.S.

(*Summary.*)

A new method is described for the quantitative estimation of longitudinal internal stress in tube shapes—for example, cold-drawn brass tubes. It is shown that the major stress is longitudinal, and the stress in the outer part of the wall of the tubing is a longitudinal tensile stress, while that in the inner portion is a longitudinal compressive stress. The summation of the balanced stresses, of course, is zero. Absence of circumferential stress in tubes is indicated by the failure of diametrically-cut rings to spring in or out on being slit in two. Experiments showed that the usual cutting methods which have been applied to bars and rods for the estimation of stress are not applicable to tubes, especially where the bulk of the stress is longitudinal.

The method described in the Paper for measuring longitudinal internal stress is called the strip method, and is carried out by slitting a narrow strip longitudinally in a piece of tubing; for example, a strip 2.75 in. long and 0.10 in. wide in a 3.25-in. tube length, and then releasing one end of such a slit strip by cutting. Stress is indicated by the springing out of the freed end, and can be calculated by a formula based upon the modulus of elasticity of the material and the distance in movement of the freed end.

The method is useful for determining the amount of internal stress in cold-drawn tubes, and for examining quantitatively the effect of a low-temperature anneal upon stress release. It has often been thought that because cold-drawn brass does not crack on application of an accelerating cracking agent, it is free from internal stress. The strip method is applicable for the quantitative estimation of stresses inferior to those necessary for cracking under the application of mercurous nitrate.

THE PARTNERSHIP heretofore subsisting between Messrs. J. Crowther and E. O. Coulthard, electrical and mechanical engineers, etc., 188, Chapel Street, Salford, Lancaster, under the style of Crowther & Coulthard, has been dissolved.

THE FIRST MEETING of the creditors of J. I. Evans and S. Evans, trading as the South Dock Engineering Company, Swansea, has been held. Mr. G. H. Horney, of Fisher Street, Swansea, has been appointed trustee, with a committee of inspection. A statement of affairs has not yet been lodged.

* A Paper read before the Autumn Meeting of the Institute of Metals.

First Conference of Special Libraries and Information Bureaux.

The first Conference of Special Libraries and Information Bureaux was held from September 5 to 8 at High Leigh, Hoddesdon, Herts. Over 80 men and women interested in various ways in the collection and dissemination of informative matter attended.

The objects of the Conference were outlined at the opening session by Dr. R. S. Hutton, Director of the Non-Ferrous Metals Research Association, and Mr. J. G. Pearce, Director of the Cast Iron Research Association. It has long been felt that many diverse agencies concerned with the treatment of information have problems in common, and needed an opportunity to establish mutual co-operation and assistance, and to determine their relationship to the Press, and to the great municipal and national libraries and other institutions.

Subsequently Mr. Allan Gomme, Librarian to H.M. Patent Office, London, Mr. B. M. Headicar, of the London School of Economics, and Dr. S. C. Bradford, of the Science Museum, South Kensington, addressed the Conference on their respective libraries.

Group meetings on the scientific, industrial and economic libraries were addressed by Mr. W. M. Corse, of the National Research Council, U.S.A., Miss L. Stubbs and Mr. H. G. Lyall. The session on economic and statistical libraries indicated valuable developments which are taking place with regard to forecasting of trade tendencies.

An address by Lieut.-Col. J. M. Mitchell, O.B.E., Secretary to the Carnegie Trustees, outlined the policy of the Trustees with regard to Special Libraries, and Mr. L. Stanley Jast, Chief Librarian in Manchester, and Lieut.-Col. E. L. Johnson, Director of the Cleveland Technical Institution, dealt with Special Libraries in relation to other libraries and institutions.

Among the details of methods and equipment Dr. J. C. Withers, of the British Cotton Industry Research Association, presented a Paper on "Abstracting," and Mr. H. Rottenburg, of Cambridge, on "A Guide to Scientific and Technical Literature." Bibliographical aids to Special Libraries, such as "The Subject Index to Periodicals" and "World List of Scientific Periodicals," were considered.

The important function of the Press in collecting and distributing information was dealt with by Mr. F. H. Masters, Editor of "The Electrician," and Mr. V. C. Faulkner, Editor of THE FOUNDRY TRADE JOURNAL, and at the concluding session Dr. E. A. Baker, Director of the School of Librarianship, University College, considered the question of training men and women for work in Special Libraries.

The Conference, which was highly successful, provided abundant evidence of the interest in this field of work, and in order to ensure continuity of interest, without forming another Association, a Standing Committee of the Conference was appointed, with power to consider matters in the interests of those engaged in directing or operating Special Libraries, and to convene a further Conference at some future date. This Committee is representative of a wide range of Institutions, and has already held its first meeting.

The most striking feature of the Conference was the keenness displayed by a large number of highly diversified interests, including scientific, technical, industrial, wholesale and retail commerce, railways, political, agricultural, governmental, Universities, Press, medical, sociological and banking. This diversity served merely to emphasise the common interest of all these agencies in receiving, treating and distributing documentary material.

MESSRS. A. WILLIAMS and F. B. PELL, electrical and mechanical engineers, 281, Gray's Inn Road, London, W.C., trading under the style of Williams, Pell & Baring, have dissolved partnership.

THE DISCHARGE from bankruptcy of Mr. R. J. de Roy, trading with another under the style of Block Deroy & Company, Carlton House, Regent Street, London, metal merchants, has been suspended for two years.

Scabs and Venting.

By J. H. LIST.

A scab is one of the faults that will reject a casting. In this matter, however, a scab, even a bad scab, will not necessarily reject some form of castings such as manhole-covers and frames, gulley grates and the like, but this article is not given for such type of work, but for the engineer's castings.

Scabs appear even on plain, easy castings just as much as the difficult ones. The explanation lies probably in the fact that the commoner class of casting is made by less skilled labour.

A scab may be briefly described as a shapeless lump on the surface of a casting, and can be caused from a core, as well as from the mould.

All scabs are caused through insufficient venting on the part of the mould and of the material on the part of the core.

Scab from the Mould.

When the metal enters the runner gate all other exits, such as risers, should be closed, and the metal closes any exit of the runner gate. The mould is full of air; this air must have free exit from the mould if the metal is to lay quietly on the sand, providing always that all other things forming the mould are in order.

There is also the gas, which is formed by the metal expelling the various substances from the loam, coal dust, and other bodies, which ignite at comparatively low temperatures, and all of which have to be got away from the metal space in the mould in the same way that the air finds exits.

Venting.

Venting, and this in quantity, is the safe and only remedy to apply. This venting must be done, firstly, by insisting that the sand forming the mould is of such a nature that air and gas under low pressures can quickly and easily penetrate, particularly that portion of the sand which forms the face of the mould.

The next thing to make sure of is that, particularly in a large casting, the bed under the box part is dry and of an absorbing nature, so that the gases can strike it easily. A large tube should be placed into the bed leading to the open, so as to give free passage of gas at this point.

The venting with the large wire must be done as far as possible before the pattern is withdrawn. If this is not done, the mould is liable to suffer from bad cracks and weakness by breaking the bond.

The top part should be well vented before it is lifted off and right down to the pattern with the large wire, remembering to vent well round the runner gate and riser. After the top part is lifted off the bottom part should be well vented, with a large wire well down to the bed, as close to the pattern as possible, but without touching it.

The author has known cases where the large wire has been too close to the face of the mould, and metal has burst through and filled up several adjacent vents, and prevented the gases getting away at that area, causing bad scabs.

When this part of the venting has been thoroughly done a common channel should be made on the joint of the mould, joining up these vents, and leading the common channel to the box edge in several places. A large wire should then be pushed well under the bottom box at the floor level, so that gases should have free passage from below the mould to the box edge.

After the patterns have been withdrawn from the mould the moulder must make sure that all these large vents are securely made up, or otherwise they will fill with metal, and at once become ineffective.

The final venting should be given with a fine wire, and all over the surface of the mould; these small vents form the tributaries to the large vents. Then small vents in turn will want making up, but this will be done effectively by sleeking and finishing of the mould. If these factors are attended to, and providing the sand is not too wet, the scabbing troubles will disappear.

Scab from Cores.

Now take the case of a scab as caused from the core. A core either made of loam or sand must be vented. If sea sand is used, and oil, less venting is required, because the sand is of a more open nature and contains no bond such as clay to close the pores; nevertheless, a little venting is desirable.

A loam core, if made of suitable material and of no great thickness, also needs no venting, but if by chance the materials differ a little, and the loam becomes closer, then if it is not vented trouble will arise, so here again perhaps a little venting is desirable.

The cause of a scab can be ascribed to the gases at this point of the mould being unable to make easy escape through the first layer of sand, and the disturbance caused was sufficiently violent to tear away the sand and thus offer a route for the escape of the gas.

Now this sand rises and moves about with the incoming iron, and ultimately comes to rest in no particular place. It may be on a part of the casting which has to be machined, it may be in such a place that would weaken the casting, as in the walls of a cylinder, in which case it probably would not withstand hydraulic test.

Preventing scabs can only be achieved by ample venting. The author quite realises that on a large mould it is a long, tiring job, but it is well worth the trouble.

Recent Developments in Non-Ferrous Metallurgy in the United States, with Special Reference to Nickel and Aluminium-Bronze.*

By W. M. CORSE, S.B.

(*Summary.*)

The general plan of the lecture was to describe recent non-ferrous metallurgical developments in the United States, with special reference to those that are new or those about which published information has been difficult to obtain.

Nickel was described from the historical standpoint, and the various outstanding data in its development are given. The occurrence of nickel was discussed, and the smelting of the ore into so-called Bessemer matte was described.

The refining methods differ with each of the three principal companies, although the smelting methods were practically the same. Each method of refining was outlined. These were the Orford, Mond, and Hybinette processes.

The properties of nickel were given, and its commercial uses are mentioned in detail. The important alloy of nickel and copper called Monel metal was described, and this topic was concluded by paragraphs on the alloying properties of nickel and its non-metallic forms.

The copper-aluminium alloy, known as aluminium bronze, was described, with special reference to its commercial development rather than its scientific development. This interesting series of alloys has found many important uses, such as for worm-gear wheels for motor trucks, automobile parts, and other structural pieces requiring resistance to vibratory stresses or fatigues.

The addition of lead to the standard aluminium bronze has given a new alloy of splendid wear-resisting properties. The result of a special test of such an alloy shows excellent results.

The dream of many a foundryman to avoid the use of sand for moulding purposes may come true if the new Holley "long-life mould" process using these moulds made of cast iron proves to be the success that is at present indicated. This applies to mass-production work. This process is described and results with reference to the economics and the practice are given.

The lecture concluded with short references to Ambrac metal, Frary metal, and the series of nickel-chromium-iron alloys occupying the field of metallurgy which may be called "No Man's Land."

* Given as the Third Autumn Lecture to the Institute of Metals.

XUM

American Foundrymen's Association Papers.

The following is a list of Papers to be presented to the American Foundrymen's Association meeting to be held in Milwaukee from October 13 to 16:—

Joint Session with Institute of Metals Division, A.I.M.E.

"Making Copper Castings from Cupola-Melted Metals," by T. F. Jennings, Garfield, Utah.

"Modern Bell Founding," by Wesley Lambert and G. Hall, London, England. Annual Institute of British Foundrymen Exchange Paper.

"Art Bronze Work," by J. F. Arnold, Mount Vernon, New York.

"Recuperation in Connection with Brass Melting," by H. D. Savage, Combustion Engineering Corporation, New York.

Report of Committee on Non-Ferrous Metals.

"Founding of Brass in Mexico," by H. H. Miller, Torreon, Coa, Mexico.

Steel Foundry Topics.

"Broadening the Field for Steel Castings through the Use of Alloys and Heat Treatment," by F. Grotts, Holt Manufacturing Company, Peoria, Ill.

Report of Committee on Steel Castings.

Report of Committee on Refractories.

"Constructive Criticism on Annealing Steel Castings from the Consumer's Point of View," by J. F. Harper, Allis-Chalmers Company, Milwaukee, Wis.

"Scaleless Annealing of Steel Castings in an Electric Furnace," by V. T. Malcolm, Chapman Valve Manufacturing Company, Indian Orchard, Mass.

Aluminium and Aluminium Alloys.

"Production of Aluminium Alloy Piston in Permanent Moulds," by R. J. Anderson, consulting metallurgical engineer, Boston, Mass., and M. E. Boyd, Clinton, Mich.

"Aluminium-Silicon Alloys," by D. Basch, General Electric Company, Schenectady, New York.

"Aluminium Alloy Castings from Sheet Scrap," by H. C. Knerr, Philadelphia.

"Salvage of Aluminium Alloy Castings by Welding and Soldering," by R. J. Anderson, Boston, Mass., and M. S. Boyd, Detroit.

"Alpax, a New Development of Light Alloys," by Dr. L. Guillet, France.

Steel Foundry.

Report of A.F.A. Representative on Joint Investigation of Phosphorus and Sulphur in Steel.

"Organisation and Practice in a Steel Foundry Finishing Room," by C. W. Heywood, Burnside Steel Company, Chicago.

"Notes on the Overall Performance of Acid Electric Furnaces," by T. S. Quinn, Lebanon Steel Foundry, Lebanon, Pa.

Apprentice Training.

"The Employer's Expectation of Apprenticeship," by R. J. Doty, the Sivyer Steel Casting Company, Milwaukee.

"The Milwaukee District Programme," by H. S. Falk, Falk Corporation, Milwaukee.

"Apprenticeship from Apprentice Viewpoint," by J. Edwards.

"Why I Talk Apprenticeship," by C. Freund.

Sand Research.

Report of Chairman of Joint Committee on Moulding Sand Research.

Report of Chairman of Sub-Committee on Tests of Joint Committee on Moulding Sand Research.

"Development and Comparison of Permeability Testing Apparatus," by T. C. Adams, Cornell University, Ithaca, New York.

"Relation of Water to Bond and Permeability," by C. R. Nevin, Cornell University, Ithaca, New York.

"Method for Direct Reading of Permeability of Sands," by A. A. Grubb, Ohio Brass Company, Mansfield, Ohio.

"Sand Control Testing in the Foundry," by H. W. Dietert, U.S. Radiator Corporation, Detroit.

"A Study of the Effect of Heat on the Clay Content of Moulding Sands, as Shown by the Dye-Absorption Test," by Messrs. Harrington, MacComb and Hosmer, Hunt Spiller Manufacturing Company, Boston.

Special Session of the Institute of Metals Division of the A.I.M.M.E.

"Casting and Heat Treatment of Some Aluminium-Copper Magnesium Alloys," by Samuel Daniels, A. J. Lyon, and J. B. Johnson.

"Experiments on the Heat Treatment of Alpha-Beta Brass," by G. W. Ellis and D. A. Schemnitz.

"Coating Formed on Corroded Metals and Alloys," by George M. Enos and Robert J. Anderson.

"Notes on Hardness of Heat-Treated Aluminium Bronze," by George F. Comstock.

Sand Research.

Report of Sub-Committee on Geological Surveys.

Report of Sub-Committee on Conservation and Reclamation.

"Notes on the Grading of Sands," by C. R. Nevin, Cornell University, Ithaca, New York.

"An Exhaustive Study of Various Moulding-Sand Mixtures, together with the Physical Properties of the Moulds and Castings Produced," by Messrs. Harrington, Wright and Hosmer, Hunt Spiller Manufacturing Company, Boston.

"The Effect of Moisture, Silt and Clay Content on Various Moulding-Sand Mixtures," by Messrs. Harrington, Wright and Hosmer, Hunt Spiller Manufacturing Company, Boston.

Electric Furnaces.

"Making Cast Iron in the Electric Furnace," by E. B. Stearns, American Bridge Company, New York.

"The Electric Furnace and Cast Iron," by F. Hodson, Philadelphia.

"Electric Furnace Iron," by E. L. Wilson, Hartford, Conn.

"The Electric Furnace in the Pipe Foundry," by J. T. MacKenzie, American Cast Iron Pipe Company, Birmingham, Ala.

Malleable Cast Iron.

"Malleable Casting Developments," by Enrique Touceda, Albany, New York.

Report of Committee on Malleable Cast Iron.

"Oxidation Losses in Melting," by H. A. Schwartz, National Malleable and Steel Casting Company, Cleveland.

"Broadening an Industry's Horizon," by C. L. Eshleman, American Malleable Casting Association, Cleveland.

"Malleablising Process," by A. Hayes and W. J. Diederichs, Iowa State College, Ames, Iowa.

Grey Iron.

"Melting Steel in a Cupola," by J. Grennan, University of Michigan, Ann Arbor, Mich.

"Notes on Composition and Structure of A.S.T.M. Bar," by J. Bolton, Niles Tool Works, Hamilton, Ohio.

"An Investigation of Chill Iron," by E. J. Lowry, Hickman-Williams Company, Chicago.

Report of Committee on Cast Iron.

"Differences in Cast Iron Produced by Melting," by W. E. Jominy, University of Michigan, Ann Arbor, Mich.

General Reports and Papers.

"A World Outlook for American Foundrymen," by H. Cole Estep, Cleveland.

"Departmental Costs in the Foundry," by Howell B. May, W. K. Henderson Iron Works and Supply Company, Shreveport, La.

"Cost Finding in a Foundry," by W. J. Corbett, Electric Steel Founders' Research Group, Chicago.

Report of Committee on Corrosion of Ferrous Metals.

Report of Committee on Coke.

Report of Committee on Pattern Standardisation.

Mr. John T. Wood, President of William Jessop & Sons, Incorporated, New York, is at present in England.

European and American Foundries Compared.*

By H. M. LANE.

European and American conditions cannot be compared without taking into account the causes which underlie their differences, nor can the practice in any given trade in two continents whose social conditions differ so greatly be compared without considering some of the causes which underlie the difference. In Europe wages have never risen so high as in America, nor has the man-hour output risen to such an extent, but the ratio between man-hour production and the wage rate is such that the ultimate production of many of the necessities is at a sufficiently low ratio to keep any foreign competition from coming in and monopolising the market. This is particularly true in the case of articles of relatively small output and which to a greater or less extent have a local use.

The amount of iron used per capita per year in any community is to a certain extent an index of the general relationship of that people to their manufacturing problem. This is modified by certain conditions in each country.

The American servant problem also has an important bearing on domestic and household equipment. The French household is usually equipped with fairly good cooking utensils, but they are made of the two good materials which are relatively indestructible. On the one hand, there is the heavy wrought copper cooking utensils, and on the other, the cast-iron utensils. Aluminium is being used more every year. These two classes of kitchen ware last a generation or more, which reduces the manufacturing problem to a minimum. Americans use cheap stamped goods, many of which are enamelled, with the average life scarcely three years.

Limited Markets.

In Europe the market is such that they cannot specialise and turn out great outputs of a product as in America, and that is why American sewing machines have to a large extent become the standard of the world. Also in Europe there is the artistic side. The average European workman is much more of an art artisan than he is a tradesman. The moulder takes pride in his work and he is an actual moulder. This limits the number of pieces he turns out but improves the quality, and where a comparatively few pieces are wanted, this is not a serious item, though if mass production is required it becomes a prohibitive handicap. In America if a man wants a small number of castings, as for instance, a special class of machine tools, they must be made under a very high wage scale, and the cost per pound rises proportionately. In Europe they are made by very much the same method, with about the same man-hour production, but the rate of wages is much lower, so that the pieces are produced more cheaply.

Climatic Influences.

The mental attitude of the manufacturers toward their problem is well illustrated in some of their practices with regard to handling appliances. The climate of much of Europe, particularly in France, Belgium and Italy, is not so severe as the climate of the United States, and their buildings do not have to be so solidly built to resist winds, nor do they have to be so heavily constructed to carry snow loads, nor so tightly built to keep out cold. Hence a light form of construction is used. Their steel trusses are made up of relatively small pieces, and generally of lattice construction. The roof trusses appear to be more like cobwebs, and the roofs themselves are largely of tile laid on a system of wooden support. In many cases the outer walls are 4½ in. The bricks at the end of each panel are built into the steel work, so that the building really consists of a series of brick panels built into the light steel work. The bricks are all laid in cement mortar. In some cases they go even further and place the bricks on edge, so that the brick wall itself is only about 2½ in. thick.

This very light construction makes a building which cannot be subjected to severe shocks or vibration. As a consequence crane runways supported on the building cannot be subjected to violent shocks, hence the cranes are run very slowly. This in turn limits their usefulness and their output and frequently necessitates putting in extra cranes. This system of adapting handling appliances to fit the relatively weak structures built only for protection is encountered in almost all branches of the work, and has a marked effect on manufacturing methods.

Utilisation of Floor Space.

There are noteworthy exceptions in which the cranes are supported on entirely separate structures, and in some cases these are of heavy masonry. In one foundry which the author visited more than 20 per cent. of the total floor space of the area occupied was taken up by masonry pillars and supports for the wall and cranes. This was an extreme case of a plant built during the war when steel was not available, but in the older foundries many have 20 per cent. of the area taken up by walls and masonry work, and extensions are being constructed in the same manner.

Thus far the Frenchman has not succeeded in comprehending the fact that not only in foundries, but in most American manufacturing plants, the management to a greater or less extent treat the entire plant with the building as a machine to produce its output, and they design the machine accordingly.

Line shafting in France is usually largely supported on a light network of lattice trusses. These would be prohibitive in America on account of the large amount of fabrication expense involved, but with their relatively low wage cost they find it cheaper to spend the money in wages than to spend it for extra metal in the structure. They do not realise that in most cases the extra metal would serve to eliminate or reduce vibration and give a more rigid structure.

Lightly Constructed Buildings.

Their concrete structures, including crane runways, are very light indeed, and in many cases would not pass the building regulations of any city in the United States, and in other cases would not pass the State factory inspection. The answer is that their cranes are all low duty and slow speed, and they do not introduce into the structure serious strains. This increases their handling expense.

It is easy to criticise another, but the criticism is unjust unless all of the factors are taken into consideration. When one considers the market rate of compensation for labour and the natural tendency of the local labour, one promptly finds that the practice, as it exists in many European shops, is for them good practice, for they are meeting a different set of fundamental conditions from those encountered in America.

The design of machine tools or foundry appliances in France and in Europe generally reflects the attitude of mind of the average workman, and much of their equipment is of relatively light construction. They are used to adjusting machine parts, and used to many conditions which Americans are trying to eliminate. Americans try to make a machine foolproof, but Europeans have not gone to that extent. Also many European machines are not worked so fast as American, and hence with them the heavy metal construction Americans have used is not a necessity.

In many parts of Europe fuel is expensive, and anything that involves fuel consumption would be looked at many times before they decided to adopt the new method. This is one reason why many shops prefer hydraulic moulding machines to compressed-air machines, for the horse power involved per unit of output between hydraulic and compressed-air is from 10 to 15 times as great for compressed-air compared with hydraulic work. When the output warrants it is easy to convince some of the larger concerns that the air unit will pay its way, but in other cases the natural conservatism will tend very strongly toward the use of hydraulic appliances. In this connection it may be said that Europeans are far more used to hydraulic appliances and their maintenance than foundrymen are in America, and this is particularly true of the foundry field.

* Extract from a Paper presented to the (American) Southern Metal Trades Association.

Examination of Iron from Konarak.*

By J. NEWTON FRIEND, D.Sc., and W. E. THORNEYCROFT, B.Sc. (Birmingham).

In 1912 a detailed description was given by Mr. Graves of the iron beams from the black pagoda at Konarak in the Madras Presidency. The temple lies some twenty miles from Puri, which is twelve miles from Calcutta, and in all probability dates back to the thirteenth century. The beams had been used as supports under the lintels of the doorways and to assist in the corbelling-in of the roof. Through the kindness of Mr. Graves and of the Secretary of the Iron and Steel Institute (Mr. George C. Lloyd) we have been able to examine a specimen of the metal.

The specimen, measuring 2.5 cm. × 2.4 cm., was polished for microscopic examination, and etched in a saturated solution of picric acid in alcohol. Some difficulty was encountered at first in obtaining a satisfactory section, due largely to the slag inclusions in the "cracks." In the centre of the specimen were a number of holes, varying in size and depth; from these radiated "cracks," as shown in the accompanying sketch (Fig. 1). The photograph (Fig. 2), taken at a magnification of 50 dias., shows a portion of the specimen near one of the cracks. The crack itself is seen as a black mass; in contact with it is a light border of ferrite, the grain boundaries being faintly discernible; while this in turn passes into a mixture of pearlite and ferrite. Portions of the specimen away from the cracks showed a fairly uniform structure typical of mild steel containing rather less than 0.15 per cent. carbon; while portions of the specimen bordered by the holes and cracks

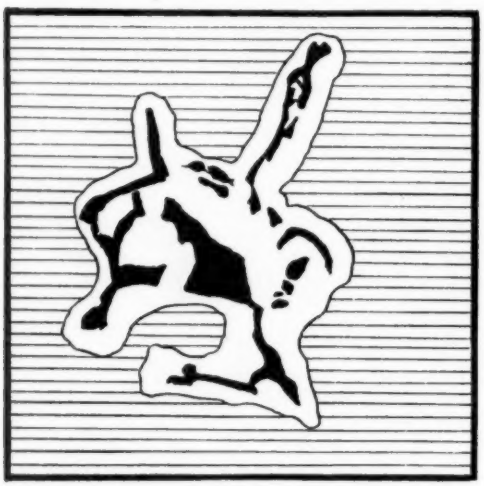


FIG. 1.—A MACROSECTION OF KONARAK IRON.
Magnified three diameters.
Black markings = holes and cracks.
White = ferrite.
Shaded = ferrite and pearlite.

showed no signs of pearlite. The examination lends support to the statement by Graves that "the method of manufacture was by welding up small blooms," and apparently decarburisation took place during the operation of welding.

The specimen was found to be very soft, the Brinell hardness number (using a load of 500 kilogrammes) having a mean value of 72—a value less than half of that (namely, 188) found by Sir Robert Hadfield for the Delhi metal.

A test was made with the Shore scleroscope in order to determine any variations in hardness. Using the magnifier hammer the hardness number varied from 31 to 28 in different parts of the specimen.

Chemical Analysis.

Owing to the irregularity of the metal it was a little difficult to choose a thoroughly representative portion for analysis. The piece ultimately chosen was as free as possible from attached slag, and its composition is given in the accompanying table, together with that of a sample of modern mild steel, analyses of specimens from the famous Delhi and Dhar pillars and from Sigiriya in Ceylon, as given by Sir Robert Hadfield, are also quoted. The low phosphorus content is noteworthy, in view of the high percentage present in the other Indian and Ceylonese specimens. The silicon is higher than in the Delhi pillar, but this may well be due to slag or other siliceous inclusion.

TABLE I.—*Analyses of Indian and other Irons.*

	Konarak iron. *c.* A.D. 1250.	Modern mild steel.	Delhi pillar. *c.* A.D. 300.	Dhar pillar. *c.* A.D. 320.	Ceylonese Sigiriya. *c.* A.D. 450.
Carbon	0.110	0.080	0.080	0.02	traces
Silicon	0.100	0.170	0.046	—	0.26
Sulphur	0.024	0.025	0.006	—	0.022
Phosphorus	0.015	0.040	0.114	0.28	0.34
Manganese	trace	0.36	nil	—	traces
Copper	—	—	—	—	0.012
Hardness (Brinell) ..	72	—	188	—	—

The carbon is a little high. On the whole, however, the composition indicates that the source of the metal was very pure. The sulphur content resembles that of the Ceylonese metal.

Corrosion Tests.

The metal was cut into a small rectangular block and exposed, along with a similar block of modern mild steel (column 2, Table I), to the corrosive influence of alternate wet and dry (tap water) for one year. It was then removed, cleaned and weighed, the loss in weight being taken as a measure of corrosion.

The specimens were then exposed for one year to action of artificial sea-water, made by dissolving the requisite quantity of Cheshire rock-salt in tap water. The tank containing the specimens held about 1 ton of sea-water.

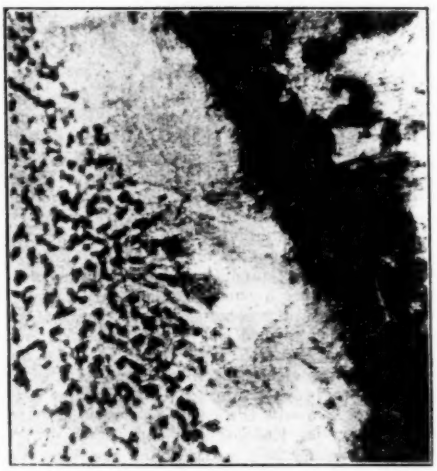


FIG. 2.—MICROGRAPH OF KONARAK IRON.
Magnified 50 diameters.

It is interesting to note that in both sets of experiments the ancient metal has proved appreciably more resistant to corrosion than the modern mild steel. It is not altogether easy to understand why this should be the case, particularly in view of the lack of homogeneity depicted in its microstructure, a feature that is usually regarded as conducive to corrosion. It is certainly very curious that, in most cases where ancient irons have been tested, their resistance to corrosion has been very marked.

TABLE II.—*Corrosion Tests.*

Konarak metal, 0.655 × 0.968 × 1.015 inches.
Mild steel standard, 0.650 × 0.985 × 1.025 ,,

Metal.	Treatment (One year each)	Loss in weight. Grammes.	Areas exposed. Square inches.	Relative corrosion per unit area.
Konarak ..	Alternate wet and dry	2.6747	3.845	89.3
Steel	Alternate wet and dry	3.0438	3.909	100.0
Konarak ..	Sea-water	0.4250	3.845	75.3
Steel	—	0.5740	3.909	100.0

In conclusion, the authors desire to thank the Government Grant Committee of the Royal Society for a grant which has enabled them to make this micrographic study.

*A Paper presented to the Autumn Meeting of the Iron and Steel Institute.

Jobbing Foundry Quotations and Estimates.

By ECOSSAIS.

The state of the jobbing foundry trade for the last three to four years has been the cause of much self-examination by owners as to efficiency, methods, costs, and the like. Those who still survive in this section of the trade must have done so either by virtue of substantial accumulated reserves, or by a combination of efficiency all round, coupled with a good knowledge of their actual costs.

To be dependent on reserves is not very satisfactory, but if provided with a good staff of workers and a graded system of costing jobs in their different grades, a foundry will thus secure the profitable jobs and be able to ignore the unprofitable.

Although there are still numbers of foundries supplying their castings at a price per cwt. to certain customers, these are bound sooner or later in the present state of trade to come to grief. Such methods are excusable in the case of repetition work, where plate and machine moulding come into play, owing to the quantities of the different castings required, but not in the jobbing trade.

The "good" jobs are always in danger of going elsewhere to be made rather cheaper, and still be profitable. The "medium" and "poor" jobs remain at the old figure, which, after the "good" jobs have departed, may mean working at a loss.

Further enterprise by the possessor of the "good" jobs, aided if need be by going in at bare cost, will probably secure to him the "medium" jobs. In such circumstances the firm still possessing the "poor" jobs must either put up the prices of these or go in search of more lucrative business.

The surest indication of the need in this country for uniformity in obtaining the probable cost of the various castings inquired after by engineers, architects, machinists, and others, is the wide difference in the quotations given by different firms. Within the last twelve months or thereabouts, in one particular instance, the quotations varied from well over £700 to little over £300, the thirty to forty firms quoting including several well-equipped and progressive firms. Allowing that the specifications were partially the cause, by including special precautions, materials, etc., it is difficult to see why one firm should be so much below the other, even though some of the firms may have intended carrying out the contract to the letter, and it is highly probable, both in the higher and the lower figures, that something was seriously wrong with their method of obtaining the cost of producing the job in question.

Specifications, whilst very often vague, are also sometimes very definite, and ask for some things, as certain brands of iron, without having any definite means of ascertaining when they are getting them. Asking for tests is, however, beside the question.

The writer vividly recalls certain castings supplied by a neighbouring firm at an all-round price per cwt. A casual observation even would have meant a division into four grades. Actually when made by the writer under conditions equally as good, a further sub-division became necessary, the cost per cwt. to produce approximating to ratios given in Column A for the seven classes or grades referred to. Column B indicates the ratio of the weights one to the other.

Grade No.	A.	B.
1	4.7	100
2	2.8	36
3	2.35	4½
4	1.5	74
5	7.0	13
6	2.2	15½
7	8.55	7½

It is evident from above figures that weight alone is not sufficient for grading or classification, and that a firm accepting a uniform price is acting uneconomically if the grades with the higher ratios as to cost increase in their proportion to the whole.

At the same time, with any one grade alone (carrying its cost according to the ratios shown) it could be made profitable, from the one with a ratio of 1.5 to the highest—8.55, with very slight and negligible adjustments in each case.

Each firm has its own formula for arriving at cost of production, and which may be more or less satisfactory, though often very limited in its application.

With a jobbing foundry, of course, the cost question is much more difficult, and frequent adjustments are necessary from time to time, whereas in the foundry engaged on a type of work regular in character, even though of several distinct grades, a simple formula may suffice, requiring very slight adjustments only at comparatively long intervals. Assuming that there is a change in the type of work, such that the whole of the floor space is fully occupied by employing only, say, two-thirds of the direct labour normally employed; or again, the full occupation of the floor space may entail the employment of an extra one-third direct labour over that normally employed.

In the latter case also the weight produced may be more, or less, than that produced in the former case. In the writer's experience, taking three different grades of work, the following figures were obtained:—

	Grade A.	Grade B.	Grade C.
Units of floor space ..	10 units.	10 units.	5 units.
Moulding hours taken	100 hours.	100 hours.	100 hours.
Weight of castings produced	9 tons.	4 tons.	7.5 tons.

Assuming that the melting equipment is equal to supplying 1.5 tons per unit of floor space, this means that with a sufficiency of castings as Grade C, 10 units of floor space would mean 200 moulding hours and 15 tons of castings.

The increase in overhead charges would be negligible, and although general labour and dressing charges would increase, the whole spread over the larger output and direct labour would mean a great difference in the cost per cwt.

The units of floor space given in the preceding examples for A, B, and C are merely given as representing relative values and not actual, and to show the possibility of having a full shop and only a portion of the normal amount of direct labour employed. With shop-establishment charges based on this normal figure for direct labour, it is obvious that these charges will not be covered in such a case. Inversely, of course, with more than the normal amount of direct labour engaged, the charges will be over-covered, and may mean too high an estimate to secure the job.

Similarly, with the above charges based on weight instead of time, these may be under- or over-charged, due to a full shop on a low or high tonnage.

Any cost system, therefore, which does not take such factors into consideration is defective as not enabling the founder to discriminate between certain grades of work which may on the face appear equally good paying propositions, or in an inverse position to that established by actual facts.

Reviewing the whole case, the writer's experience shows that floor space occupied, direct labour required, and weight of the product must be considered in conjunction when building up estimates, so that the founder is safeguarded in the event of the preponderance of any one type.

Even in times of cut prices this is necessary, and when such cuts are made these should be made visible also in the final figure, so that there are no illusions as to the standing of that particular contract when it happens to be secured.

To a great extent the grades are sufficiently mixed so as to balance each other from the founder's point of view, meaning that one customer is paying more than his share and indirectly benefiting another customer. Really another way of saying that "What is lost on the swings is gained on the roundabouts." The real moral, and one that would bring more permanent benefit to founder and customers generally, would be to concentrate on "roundabouts" with reduced "gains," and put up the price for "swings," in this way making each grade self-supporting.

Recent Developments in Foundry Education and Training in France.*

By J. G. Pearce (Director of the B.C.I.R.A.).

The scheme recently put into operation by the French Foundry Employers' Association (the members of which are interested in both ferrous and non-ferrous metals) is to encourage entry of suitable youths to foundries by providing systematic apprenticeship and training courses for all, and means whereby any young man of capacity and intelligence may obtain the knowledge and experience necessary to fit him for any position in the industry to which he may be promoted. An important feature of the scheme is the establishment of the Foundry Technical School at Paris.

Apprenticeship.

For some years the French Foundry Employers' Association has been gravely concerned with the problem of securing suitable foundry labour of all grades, and believes that the main difficulty is one of recruitment. It was considered probable that a good type of educated youth would be attracted to foundry work in sufficient numbers if he could visualise a proper scheme of training which would assure him a definite trade, and which would enable him, if fitted, to be promoted to positions of responsibility in the industry.

Founders are therefore urged by the Association to take apprentices into the foundry to the extent of 5 per cent. to 7 per cent. of the foundry labour employed, to select them carefully, and to pay them at least as much as non-apprenticed workers of the same age. All the methods commonly known in this country for attracting youths to a trade are employed—visits of school boys to works and foundries, lectures on foundry work and its possibilities, co-operation with schoolmasters in placing boys, etc. Many boys, without knowing exactly what they want, express a desire to be mechanics or electricians, and these can often be directed to the foundry. During a probationary period of two months the would-be apprentice can be watched, and his health and physique, powers of observation and skill may be noted.

For practical training, the grouping of apprentices in the foundry under a carefully chosen skilled workman, as apprentice supervisor, is recommended. Such a man must have a natural liking for boys and an aptitude for teaching. Apprentices, who should be employed on carefully graded commercial work, should be under supervision for a period of two or three years, three years being the recommended duration of apprenticeship, after which boys should be permitted to work at rates of pay corresponding to their capacity. Experience in several foundries as journeymen is also considered desirable, training being obtained in one foundry during apprenticeship and practical experience in a variety of foundries later. A written apprenticeship agreement is usual. Week-end lectures, prizes, and other inducements are used to evoke an interest in the work.

Part-Time Instruction.

District Associations of Foundry Employers are recommended to arrange courses of instruction for foundry apprentices, that followed during the first year of apprenticeship being similar to those held for fitters and patternmakers, such subjects as arithmetic, geometry, and drawing being included. Two courses—A and B—specially suited to foundry apprentices have been drawn up in great detail to cover the last two years of apprenticeship.

Course A includes both lectures and practical work, drawing, etc. It covers the raw materials, sands, pig-irons, refractories, blackings, fuels, used in the foundry industries; the methods of melting and casting, including blast furnace cupola, and other furnaces, and auxiliary equipment, patternmaking, moulding, core making, fettling and finishing; scientific control and elementary metallurgy; foundry lay-out and organisation.

Course B includes dry- and green-sand moulding and casting practice and methods in great detail for both ferrous and non-ferrous metals. Instruction is given in the physical and chemical principles underlying moulding practice and in the use of tools and the preparation of moulds.

After taking these two courses and having reached the end of his third year, the apprentice is ready to become a journeyman. If he has the desire and capacity to take more responsible positions the further facilities required are provided. In general he will follow a further preparatory part-time course held for two evenings each week, with a view to qualifying for entry to the Foundry Technical School, which gives the highest and most specialised instruction available in founding.

Foundry Technical School.

The initial impulse towards the foundation of this school came from M. E. V. Ronceray, the well-known French founder, in a Paper delivered to the Foundry Congress at Liège in 1921. The French Foundry Employers' Association actively interested itself in the question, and by the middle of 1923 a scheme was planned. The Government offered the use of certain lecture rooms and workshops at the National School of Arts and Crafts in Paris, and in January of the present year the school opened its first session. The necessary funds are supplied in equal shares by the Government and the Foundry Employers' Association, the students paying a small fee, about £5 per annum for French students and £10 for foreigners. The Foundry Employers' Association has operated through its Apprenticeship and Education Committee, of which M. Ronceray is chairman, and the governing body of the school consists of members nominated by the Foundry Employers' Association and by the Minister of Education, acting for the Government. M. Ronceray is Director of Studies at the school, the administration being undertaken by the Director of the School of Arts and Crafts, in whose building the school is housed. Since the school aims at training men for the highest positions in foundry work, a certain degree of previous education and experience is necessary. Applicants for admission are of two kinds, the most capable workmen in the industry trained through the apprenticeship system outlined above and ex-students of the technical high schools, such as the School of Mines, School of Arts and Crafts, etc. The former will lack scientific and technical knowledge, and the latter practical skill and experience. The admission examination, therefore, comprises two parts—a section relating to elementary algebra, geometry and trigonometry, physics, chemistry and drawing, and a section relating to foundry materials and practice. Technical school students may secure the latter knowledge by a year's training in a foundry, and journeymen the former through the special part-time preparatory courses referred to above.

During the first session there have been 18 students, and it is anticipated that in the next session there will be 50. The courses at the school comprise both lectures and practical work, taking up each morning in the week for four hours. One afternoon is devoted to a visit to a works or laboratory, the remainder being free for the student's own private study, for which the school remains open. Each lecture of two hours includes half an hour's questioning and discussion.

The lectures, which are delivered by well-known metallurgists and founders—such as Portevin, Ramas, Remy—number 160, with 70 practical sessions in the pattern shop, foundry, laboratory and drawing office. The metallurgy of ferrous and non-ferrous metals, foundry organisation, production systems, and scientific control, are included together with complete studies of the raw material and methods employed in the industry. At the end of the year each student writes a thesis on a chosen subject, and is examined. Satisfactory work throughout the year and at the examination entitles the student to a diploma as engineer of the school.

* Extracted from the Bulletin of the British Cast Iron Research Association.

The working of this ambitious scheme will be watched with considerable interest, as it has been evident that, in this country, there are difficulties in the industry in securing the services of suitable youths as apprentice moulders and coremakers; there are also difficulties in employing men for responsible posts in foundries for management or control of production, as the academically trained metallurgist has often a too-limited practical experience, while even the best moulders and foremen are inadequately equipped on the technical side. The French scheme endeavours to repair through one system the deficiencies of both, and will undoubtedly aid in developing a group of foundry engineers, competent to handle foundry problems, including purchasing, costing, production, moulding and melting practice and testing, in an efficient manner.

Non-Ferrous Furnace Refractories.

By "CELSIAN."

Refractories employed in connection with non-ferrous furnaces have not been investigated with the same thoroughness as in the ferrous branch of metallurgy, partly due to the smaller part which the former play in foundry work.

In view of the fact that non-ferrous furnaces are not expected to attain exceedingly high temperatures, less consideration has been given to the requirements of their linings than where metals such as iron and steel are to be melted. The lining varies, of course, with the class of material to be melted and the process to be conducted.

To prepare the most satisfactory kind of brick a thorough knowledge of the metallurgy of the smelting work is essential, together with experience of the furnace construction. This does not only apply to chemical changes which occur in the metal and slag, but also to the heavy wear and tear which is occasioned where prolonged slagging processes are necessary.

Chrome Bricks in Copper Furnaces.

The abrasive action of gas flames is well known, and need not be repeated here. Considerable controversy arose when siliceous linings were replaced by chrome bricks in copper-refining furnaces. Their use proved economically disastrous, as the absorption of molten copper was much heavier than was expected, and the cobbing exceedingly difficult of treatment in the blast furnace used for the recovery of absorbed copper. In the settlers—where the copper is allowed to separate out from the slag—the amount of copper lost was very serious.

This was due to improper settling, attributed to the use of chrome bricks. These facts resulted in the copper-refining firms reverting to their old practice of using siliceous linings. Research work for refractories in this class of refining is now largely carried out on the lines of finding a siliceous material which possesses great ability to support stress up to a temperature of about 1,500 deg. C.

It is unnecessary to consider the effects of higher temperatures, as few non-ferrous metals remain unmelted at this degree. In many cases leakages of metal from the furnace bed are attributed to bad qualities in the brick, the fact being generally overlooked that the life of the furnace is principally determined by the effects produced after alternate heating and cooling has taken place. The use of strong fluxing agents, such as fluor spar, is largely responsible for rapid deterioration of the lining with almost any variety of siliceous material. High silica refractories are preferred for those parts of the furnace out of contact with the fuel, and where high temperatures are produced—*i.e.*, the roofs and walls of reverberatory, annealing, roaster, and refining hearths in general. These same bricks, however, are not suitable for lining pit fires or other forms of crucible furnace. On the other hand, basic bricks prepared from low-silica content clay are not suitable, as they are fusible, and the large contraction in area would tend to cause a loosening, or at least weakening, in the structure of the furnace.

Magnesite Bricks.

Magnesite bricks show a tendency to crack, and spall badly when subjected to alternate heating and cooling. This is particularly evident in furnaces where copper is refined. Before any particular class of silica brick is selected for a refining furnace lining it is usually subjected to a thorough analytical and physical examination. Within certain limits, ferrous oxide produces no detrimental effects on the physical properties of silica bricks. As ferrous silicate is a strong solvent, the qualities of the brick are enhanced (beta-quartz being more rapidly transformed into tridymite).

The presence of alkalis is of little account with silica bricks, but when alumina and ferrous oxide are also present, it leads to a breakdown of the structure. On heating alkalis with alumina and silica, felspar is formed, which melts at a comparatively low temperature. One part of alkali is capable of forming six parts of liquid felspar, so that even minute percentages of this impurity are undesirable.

When high temperatures are used, the difference in the plasticity of the brick is soon noticeable when alkali is present. Lime is used as the binding material for silica bricks, which forms an unstable hydrated silicate, which, when heated, loses water, binding the grain of the silica together. The percentage of lime permissible varies with the proportion of iron and alumina. That is, the percentage of lime is reduced as the proportion of iron is increased. When too much iron oxide is present, the lime is not capable of bleaching, and the brick may remain abnormally coloured. Where lime Dinas bricks are prepared, an addition of one or two per cent. of lime is used as the binding agent, usually added in the form of cream of lime.

Clay-Bonded Silica Bricks.

Clay is sometimes used instead of lime, but the qualities of the brick are not so good. These latter bricks expand considerably with the increasing temperature, but this is unavoidable, even when the best materials are employed. As this class of brick is so sensitive to changes of temperature and does not offer great resistance to the action of slags, it has not come in for very great application, and is principally used in furnace-roof construction. Lime Dinas brick are much more used in steel furnaces than in the non-ferrous smelting processes, but of later years are being given more consideration in the latter work. The variety of brick most commonly used in the construction of the non-ferrous furnace in general contains approximately 30 per cent. of alumina, the remainder being mainly silica. The advantage secured is a combination of the stability of the basic alumina with the fire-resisting properties of the silica.

For the repair of furnaces, ground ganister made into a paste with water is generally employed. By rapidly firing this material, permanent expansion takes place and prevents it from loosening or falling out. For binding repairs, a good mixture to use is silica mixed up with sodium silicate solution. In those instances where a strong shrinkage is expected, it may be partially neutralised by addition of quartz, which causes expansion when the mixture is heated.

The Determination of Sodium in Aluminium.*

By D. M. FAIRLIE, M.Sc., AND G. B. BROOK, F.I.C.

Summary.

A process is described in detail for separating sodium from aluminium which, while possessing reasonable accuracy, could be carried out by the average laboratory assistant. The difficulty of the process will be realised when it is stated that sodium has always appeared among the constituents specified by Government Departments as not allowable in aluminium beyond a trace (0.05 per cent., afterwards reduced to 0.03 per cent.).

The accuracy of the process is much greater than that yielded by the majority of analytical methods, particularly in view of the fact that the sodium is probably in suspension, and not in solution in the aluminium. With high purity samples of aluminium, showing a sodium content of 0.08 per cent., the result of many analyses shows a mean error not exceeding 0.001.

* A Paper presented at the Autumn Meeting of the Institute of Metals.

The Analysis of Grey Iron Foundry Alloys.—V.

By H. H. S.

Evolution Method for the Estimation of Sulphur. Solutions Required.

Hydrochloric Acid.—The recommended strength is two parts of acid to one part water, 1,400 c.c. of pure concentrated HCl mixed with 700 c.c. of H_2O will form a convenient volume for storing in a Winchester quart bottle. The remarks made in the previous article concerning this acid should be borne in mind, and the results so obtained clearly labelled on the bottle.

Starch.—The writer has observed that a 0.4 per cent. solution gives a very satisfactory reaction, stronger solutions tend to decrease the delicacy of the end point. The solution should be made from *soluble* starch; this type of starch keeps in good condition longer than the ordinary variety, but for best results as an indicator no more than a week's requirements of solution should be made up at a time. To make the solution, form a thin paste by mixing the required amount of starch with a little cold water, then add boiling water to dilute to the volume required, boil for a minute or so and cool, keep in a glass-stoppered bottle.

Iodine.—This is best made up in two-litre volumes at a time, and stored in a dark blue or brown Winchester quart bottle, having a well-fitting glass stopper. An N/60 solution is a very satisfactory strength to use for titration: it is prepared by dissolving 4.234 grs. of pure *resublimed* iodine in 150 to 200 c.c. of 10 per cent. potassium iodide (KI) which should be contained in a litre flask, the solution is constantly shaken until the iodine is dissolved, and it is then made up to one litre, with cold distilled water, and transferred to the bottle, to which another litre of H_2O is added from the litre flask first used. The dissolving of the iodine is hastened by treating with the small amount of KI as described, if nearly a litre of H_2O is used and the KI added to this the iodine takes much longer to dissolve; using a *one* litre in place of a *two* litre flask enables the former to be washed free from iodine solution by the second litre of H_2O which is required to make the volume required.

One c.c. of N/60 iodine equals 0.0002666 grs. of sulphur, or 0.0066 per cent. S on a 4-gramme sample.

Ammoniacal Cadmium Chloride.—Weigh out 28 grs. of cadmium chloride and dissolve in about 250 c.c. of warm water, filter if necessary, dilute to 750 c.c. and transfer to a "Winchester," then add 1,250 c.c. of concentrated NH_4OH. Ten c.c. of this solution will contain sufficient cadmium chloride ($CdCl_2$) to precipitate quite four times the amount of sulphur likely to be encountered in ordinary foundry work. Some chemists use very much larger quantities of $CdCl_2$, but the writer has proved by experience and further consideration of the chemical equivalents of the reactions involved show that such quantities are unnecessary.

The main reaction taking place during the determination is the formation of cadmium sulphide:—

$$CdCl_2 + H_2S = CdS + 2HCl;$$

the HCl formed being neutralised by the NH_4OH present in solution, this NH_4OH also neutralises any HCl gas which may pass over from the evolution flask into the absorbing vessel, hence it is wise to use a highly ammoniacal solution as indicated.

From the above simple equation it will be apparent that 32 parts of sulphur require 112.4 parts of Cd to form 144.4 parts of CdS, 112.4 grs. of Cd are contained in approximately 219 grs. of the cadmium salt $CdCl_2.2H_2O$, so that 219 grs. of the cadmium salt will react with 32 grs. of sulphur to form 144.4 grs. of CdS, therefore 1 gr. of the salt will react with $\frac{32}{219} = 0.146$ gr. (approx.) of S.

The absorption solution contains 28 grs. of $CdCl_2$ per 2,000 c.c., 10 c.c. is used for each estimation which is equal, therefore to $\frac{1.0}{0.14}$ of 0.146 = 0.0204 gr. S, or 2.04 per cent. on a 1-gr. sample and 0.51 per cent. on a 4-gr. sample.

The Apparatus.

The following are required to fit up one complete sulphur-determination apparatus:—The hot plate should hold from six to eight sets of apparatus without any difficulty. It should be of cast iron $\frac{1}{4}$ in. thick, and should be mounted on legs 3 to $3\frac{1}{2}$ in. high, according to the size of burner used. The plate is recommended to be flanged on each side.

A Fletcher-Russel bar burner, having a 12-in. flame, will be found a very satisfactory heating medium: it is advisable to support it on an asbestos board, which is itself supported from the bench so as to allow an air-space between the burner and the bench: this prevents damaging of the bench by the heat.

The individual apparatus required consists of a 500 c.c. flat-bottomed flask, with 2-hole bung to fit: a 12-in. thistle funnel of the two-bulb type: two lead collars (slit), about $\frac{3}{4}$ in. deep, cut from $1\frac{1}{2}$ in. external diameter piping: a 250 c.c. squat form beaker: a 2 oz. squat form sample bottle fitted with 2-hole rubber bung; a hydrometer cylinder, about 8 in. × 2 in., and glass and rubber tubing, 3 and 4 mm. internal diameters.

There are very many different forms of sulphur apparatus described in text-books: some are far too elaborate for routine work, while others often described as simple are in not few cases too "simple" to give accurate results, because insufficient attention has been paid to faults or discrepancies which can so easily creep into the estimation, and which in many cases can be so easily eliminated. The permitting of the passage of HCl gas in any quantity into the absorbing solution is one of the most important, as is also cooling of the gases. The apparatus illustrated in Fig. 9 was constructed with the view to cutting

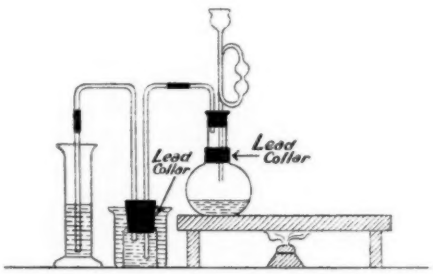


FIG. 9.—APPARATUS FOR THE VOLUMETRIC DETERMINATION OF SULPHUR.

out as far as possible the discrepancies indicated, and avoiding the use of costly or elaborate apparatus. It has been used by the writer for several years, and is recommended for routine laboratories where results are required rapidly and to be accurate.

Fig. 9 shows how the apparatus is set up. It is inadvisable to allow the stem of the thistle funnel to pass beneath the surface of the liquid in the flask; if it does there is a danger of the liquid frothing up and out of the funnel during the time immediately before the liquid comes to boiling. The right-angled tube nearest the flask on extending into the small bottle should pass nearly to the bottom of the bottle to ensure maximum condensation of the HCl gas. The beaker contains a little cold water sufficient to cover the body of the condenser. It is advisable to swill out the condenser after one or two determinations have been made with the apparatus. This keeps the amount of condensed liquid at a minimum.

The Estimation.

Light the burner beneath the plate about 20 mins. before required. Into the flask place 4 grs. of the ground and sieved drillings; they are easily and rapidly transferred to the flask without loss if placed first in a paper chute. Wash the inside of the flask down with a little water from the mouthpiece end of a wash bottle; this removes any adhering particles, and also pre-

vents the flask cracking when it is standing on the hot plate, and the addition of the acid is made. Into the absorbing vessel pour 10 c.c. of $CdCl_2$ solution, and add 50 c.c. H_2O, then connect up the whole apparatus. Now add, by pouring through the thistle funnel, 50 c.c. of HCl (2 to 1). At this point set an interval timer alarm clock for an 8-min. period.

Under normal conditions, and with the apparatus above described, the liquid will reach boiling point within 5 to 6 mins., and most of the sulphur, if not all, will have been removed. The remaining 2 or 3 mins. ensures the complete removal of H_2S from the flask, tubes and condenser into the absorption solution. Some pig and cast irons may require a 10-min. period of heating, but in all cases the heating should not be continued for more than 3 mins. after the liquid presents a clear boiling or simmering surface. At the end of the period first disconnect the absorption apparatus, then the flask from the condenser, and remove the former from the plate. Fill a 50 c.c., graduated in $\frac{1}{10}$ c.c. burette, with the standard iodine solution; then pour into a 600 c.c. tall form beaker 50 c.c. of *distilled* water, plus 30 c.c. of HCl (2 to 1) and 5 c.c. (measured from a pipette) of starch solution. Wash any CdS adhering to the tube, passing into the $CdCl_2$ solution into the absorption vessel after stirring. Run a few c.c. of iodine into the beaker. The number of c.c. will, of course, depend upon the amount of S it is expected that the sample will contain, as obviously, in the case of very low sulphur irons, one has to be careful not to add too great an amount of iodine. Now pour gently down the sides of the beaker the CdS liquid, pouring with the left hand, and imparting to the beaker a gentle swirling motion with the right. As the intense blue colour shows signs of changing, stop adding the CdS, and add a few more c.c. of iodine, then carry on as before, taking care to maintain an excess of iodine until nearly all the CdS has been titrated. When this is arrived at, place the straight delivery tube into the cylinder, and pour into the latter the partially titrated solution from the beaker. It will probably change in colour. Quickly pour back into the beaker, and finish off the titration. The end point is very sharp; it is marked by a change in the colour of the solution from a bluish purple to a true blue, and is delicate to 0.1 c.c.

A further important point to note in connection with this method of sulphur estimation is that the quantity of HCl added to the beaker to react with the CdS *should in every case be measured, and no more than stated.* Too great an excess hinders the delicacy, and possibly the accuracy of the titration, as the colour, instead of being true blue, retains a reddish tinge.

A very low sulphur—less than 0.03 per cent.—will give a deeper blue for the same fineness of burette reading as a high sulphur, but the accuracy is not impaired; it is merely the end point which is sharper.

The "standard" is dealt with in exactly the same way, and the c.c. of iodine required divided into the percentage of sulphur gives the percentage factor per c.c. of iodine, which, as previously stated, should agree closely with the theoretical factor or equivalent.

The c.c. of iodine required by a sample under test X the factor equals sulphur per cent.

A New Alloy.

At the Atlantic City meeting of the American Society for Testing Materials some details were given of a new alloy called "Admiralty nickel," Admick being its trade name. It has been developed by Mr. W. B. Price, of Scovell Manufacturing Company of Waterbury, Conn., U.S.A. It is said to contain 70 copper, 29 nickel and 1 per cent. tin. In the cold rolled condition the alloy is reported to return 58 tons per sq. in. and in the annealed 34 tons, both associated with a good elongation and reduction of area. It is also stated to be resistant to alkalis, salts and other materials. The metal is strong at high temperatures and is extremely ductile. It was announced that the metal is capable of being drawn from a $\frac{3}{8}$-in. round bar down to wire having a diameter 0.006 in. with annealing.

Foundry Query.

The Running, Feeding, etc., of a Cast Steel Friction Clutch.

[*Issue July 17, page 55.*]

In answer to the above query, when moulding this class of work the runner should be placed below the circular projection of the mould as at D, Fig. 1. This projection should also be carefully vented and connected with a number of $\frac{1}{8}$-in. open vents from the underside at A. The runner should be cut, to give a spinning movement to the metal when casting. Also it is advisable to give a full head allowance approximately 75 per

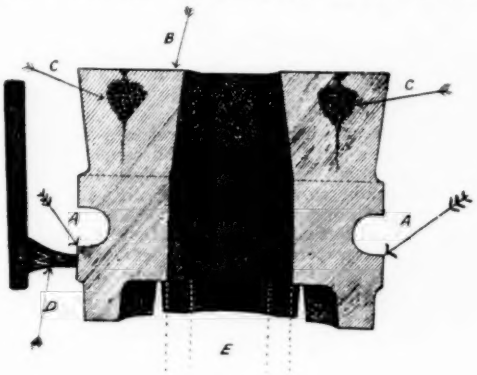


FIG. 1.

cent. the weight of the casting, as at B, and further to extend the core so that it cuts through the head, as shown. The core should be made beforehand, which will enable it to be placed in the mould before stoveing and rammed firmly in position.

When finishing off the mould, all sharp corners should be eliminated and filleted where possible, and, after closing, the core should be centred

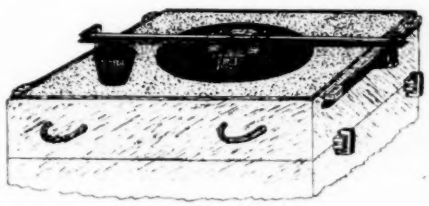


FIG. 2.

from the mould and not the head, which is apt to be misleading. The core is held down by means of a crossbar as in Fig. 2. At C, Fig. 1, is shown the probable piping cavity due to the rapid solidification of the steel, thus illustrating the utility of a good head allowance.

After casting, the head should be prevented from crusting over at the top, and kept open by using a wooden rod and pieces of charcoal. This will enable the cavity to be filled up, after casting some of the other work on the floor.—H. V. F.

London Metallurgical Courses.

The Chelsea Polytechnic, Manresa Road, London, S.W.3, is again organising a series of courses in metallurgy for evening students, starting next week. There is no actual foundry course of lectures, but at least five out of the eight courses arranged are directly applicable. Mr. W. A. Naish, a prominent member of the London Branch of the Institute of British Foundrymen, is the lecturer, and foundrymen can thus rest assured that matters of interest to them will be stressed.

A PETITION FOR THE WINDING-UP of the Birchfield Foundry Company, Limited, will be heard at Birmingham on September 18.

THE MIDLAND FOUNDRIES, LIMITED, are being wound up voluntarily, with Mr. G. H. Tyler, 43, Cannon Street, Birmingham, as liquidator.

XUM

Notes on Melting and Pouring Brass and Bronze.*

By L. S. Wolf and Wm. Romanoff.

Pouring Temperatures.

No single operation in the foundry has more influence in determining the quality of the ultimate finished product than that of pouring at the proper temperature. If, in order to obtain a better metal, the man in charge took the necessary steps, while melting, to see that the molten metal was properly covered and that it was not permitted to "soak" in the furnace; he ascertained that the furnace atmosphere was correct, whether it be oxidising, neutral or reducing; he used any type of furnace, whether it be open-flame, crucible or electric; he used any mixture of scrap and virgin metal; the results of all these precautions would be offset if the metal were poured at an improper temperature. This statement may at first thought appear to be ambiguous, but upon further analysis foundrymen will no doubt agree. Or, better still, a trial will surely convince them.

In the author's brass foundry they manufacture valves, line material for electric railways, mining material, etc. In the case of one alloy 50 per cent. virgin metal and 50 per cent. domestic gates and sprues were used. Merely a difference of 50 deg. C. between the proper temperature (A) and the improper temperature (B) gave the following difference in physical properties:—

Temperature.	Tensile strength in tons per sq. in.	Elongation per cent. in 2 ins.	Reduction of area per cent.
A	12.3	14.6	15.3
B	7.2	7.5	6.4

The same furnace conditions were maintained in each case. In fact, A and B were poured from the same pot of metal. Test bars and castings were poured at temperature B and the remaining metal chilled down with gates and sprues to temperature A and poured.

The above results are consistent with theory and with the results always obtained in practice in the author's foundry since the introduction of temperature control. Molten metal has a tendency to absorb gases, the higher the temperature the more gases absorbed. Upon cooling these gases are given off. When pouring a casting, the outer surface solidifies first. Therefore, the higher the pouring temperature the more gases entrapped between the crystals of the metal and necessarily the less dense and more brittle it will be.

When the castings leave the foundry, they are sent back to the brass casting department, where the castings are cut off from the gates, after which they are rough ground and sandblasted. They are then inspected and divided into the following groups:—Misrun, dirty, shifted and good castings. Shifted castings are due to faulty moulding or pattern equipment, and will be eliminated from this discussion. The percentage of dirty castings is greatly increased when poured at too high a temperature. This is accounted for as follows:—If the metal is excessively hot, the temperature is such that it retains the oxides and other impurities in a fluid or plastic condition. When pouring the metal in such condition, the surface of the metal in contact with the mould solidifies, thereby entrapping oxides and impurities and causing "dirty" castings. If the metal is chilled to proper pouring temperature the oxides and other impurities are permitted to solidify and, due to their lower specific gravity, float to the surface. The slag can then be readily skimmed off. If the metal is too hot, it also has a tendency to "eat" into the sand, causing rough, dirty castings. On the other hand, pouring the metal too cold is likely to cause "misruns."

To give a further illustration of the effect of pouring at too high a temperature, the case of pouring another alloy is cited. In this particular case 50 per cent. of scrap and 50 per cent. of virgin metal were used. Again, as in the previous alloy, there was only a difference of 50 deg. C. between the higher or improper pouring temperature B and the proper pouring temperature A, with the following difference in physical properties:—

Temperature.	Tensile strength in tons per sq. in.	Elongation per cent. in 2 ins.	Reduction of area per cent.
A	16.0	27.6	32.9
B	11.3	14.7	18.7

When metal is overheated or permitted to "soak" in the furnace for too long a time, there is gasification of the metal taking place instead of an oxidation which is generally supposed to be the case. That probably accounts for the fact that upon chilling an overheated metal it practically returns to its normal state. The pouring temperature should be as low as possible, consistent with the size and shape of the castings in order to obtain the best possible physical properties.

Comparison of Melting Furnaces.

There is always a question as to the quality of metal produced by different types of furnaces. In the author's brass foundry three types of furnaces are operated—the open flame type, as represented by Schwarz furnaces; the crucible type, as represented by Steel-Harvey furnaces, and the electric, as represented by an indirect arc-type furnace. As the management insists that everything be subservient to quality in the manufacture of their products, they have experimented extensively to determine whether one or more of these types of furnaces should be eliminated from the foundry due to producing an inferior grade of metal.

Costs.

This is the standard upon which the majority of concerns base their conclusions as to whether any equipment or process is to enter into production. It is especially prevalent among the smaller concerns. The cost of melting one ton of metal in electric, Schwarz and Steel-Harvey furnaces is as follows:—†Electric, 22.99; †Schwarz, 20.38; and †Steel-Harvey, 17.86 dollars.

This comparison includes fuel, labour, lining, melting losses, crucibles and all other incidental items necessary to melting metal, and was compiled during a long period of time. In addition, the slag recovery is also included as a concentration plant is operated.

Quality.

A comparison of the quality of the metal melted in the above-mentioned three types of furnaces will prove interesting. In fact, it is contrary to the opinion which is almost universally prevalent among foundrymen about the decidedly superior metal obtained in an electric furnace as compared to other fuel-fired furnaces.

Furnace.	Tensile strength in tons per sq. in.	Elongation per cent. in 2 ins.	Reduction of area per cent.
Electric ...	12.7	18.1	18.7
Schwarz ...	12.3	14.7	14.0
Steel-Harvey	11.9	16.1	15.2

While the advantage seems to be slightly in favour of the electric furnace, it is so small that it need hardly be considered. But the electric furnace is by far the most fool-proof. Proper furnace conditions, as well as pouring temperatures, must be maintained in order to obtain as good a quality of metal from the Schwarz and Steel-Harvey as from the electric. Wherever possible, comparisons were made upon the finished castings poured from the various furnaces, and any difference in quality was hardly noticed.

Another phase which is coming into consideration more and more every day is that of zinc fumes. From a humane standpoint this must be considered. The electric furnace, with its sealed melting chamber, is far superior in eliminating

*Abstract from a Paper read before the American Foundrymen's Association. The authors are connected with the Ohio Brass Company, Mansfield, Ohio, U.S.A.

†Power for electric furnace has been figured at the rate of 2 cents per K. W. H. Fuel Oil for Schwarz and Steel-Harvey furnaces at 6 cents per gal.

this evil. With labour at a premium as at present, working conditions should be such as to keep the minds of the employés in a contented state, and the electric melting furnace is a step in the right direction.

Mixes.

Every foundry that operates a machine shop has a continuous influx of brass borings and turnings to be remelted. In addition, there are the gates and sprues. As near as possible it should be the aim to consume all of this scrap material in the foundry in the same proportion as it is received, thus avoiding any unnecessary accumulation. This greatly reduces the cost of the raw material as compared to what it would be if all virgin metal were used in the manufacture of castings. Considerable experiments had to be made to determine whether this scrap would be detrimental to the metal, and, if not, in which proportions it could safely be added. In carrying out these experiments all melting and pouring conditions were maintained as uniformly as possible, the only variations being in the combinations of scrap and prime metal used.

In the manufacture of one of the bronze alloys three combinations of metals were used, one consisting of all prime metal, one of equal parts prime metal and scrap, consisting of gates and sprues, and one containing all scrap, consisting of gates and sprues. The following results were obtained:—

Per cent. scrap.	Tensile strength in tons per sq. in.	Elongation per cent. in 2 ins.	Reduction of area per cent.	Brinell hardness.
0	16.5	23.4	21.2	72
50	15.4	21.1	21.0	68
100	17.2	22.9	21.1	68

While there is a slight reduction in the tensile strength when using half scrap and half prime metal, still there is no radical difference. The elongation, reduction of area and Brinell hardness are practically the same, using any of the combinations.

In another case combinations of prime metal scrap were used, such as gates and sprues, and composition ingot metal purchased from various smelting and refining companies. These were used in the melting of one of the brass alloys. Composition ingot is usually obtained by the refining of concentrates, borings, turnings, etc. The following results were obtained:—

Mix			Tensile strength in tons per sq. in.	Elongation per cent. in 2 ins.	Reduction of area per cent.	Brinell hardness.
Per cent. ingot.	Per cent. scrap.	Per cent. prime.				
0	33	67	10.9	14.3	13.0	52
25	27	48	10.6	13.2	9.4	54
50	33	17	10.3	12.2	10.1	50
75	0	25	11.9	16.1	15.2	48

There is some variation in the reduction of area, but the remainder of the results are fairly consistent.

Still another brass alloy was melted, using 25 per cent. of borings in one case, the remainder being ingot, scrap and prime metal, and in another case the borings were eliminated. The following results were obtained:—

Mix.	Tensile strength in tons per sq. in.	Elongation per cent. in 2 ins.	Reduction of area per cent.
With borings ...	12.3	14.7	14.0
Without borings	12.8	16.9	17.6

These results are again consistent.

In the combinations of scrap and prime metal used there is the fact that when all other conditions are equal there is a greater shrinkage in the castings the more prime metal used in the mix.

Any reasonable combinations of prime metal and scrap can be used, providing there are not too many detrimental impurities present, such as antimony, iron, etc., and that proper foundry conditions have been maintained.

Fluxes.

The authors do not wish to put themselves in the position of belittling any flux. Probably they do not know how to use a flux. In their investigations they merely carried out implicitly the written instructions of the flux manufacturers. And in each case the physical properties were no better with the use of a flux than without. All other foundry practices were the same in both cases. It may be good business psychology to tell customers that in the manufacture of a product the best and highest price fluxes obtainable have been used, but psychology never prevented "leakers" in valves nor increased the toughness of a trolley wheel.

In the melting of brass or bronze alloys the red metal is melted first, and when molten the white metal is added. About 5 to 10 minutes later the metal is poured. In the interim between adding the white metal and pouring the melter adds a little sand as a covering to prevent as much volatilisation of zinc as possible while the metal is molten—that is the only flux used.

If the foundry uses scrap of unknown quality and the melting conditions are questionable, there might be some advantage in using fluxes as scavengers. If foundry practice is under control and one is using a high-grade scrap of known analysis, there is no particular advantage in using these high-priced fluxes.

Deoxidisers.

The authors have found phosphor copper containing about 8 to 10 per cent. phosphorus to be the most practical. A fraction of an ounce per pot of metal, containing 100 to 150 lbs., is added just before pouring. When an excess was added the metal became so active it "cut" the sand in the moulds, causing rough, dirty castings; castings deteriorated due to the formation of the hard, brittle Cu_3P compound. In the high-lead alloys the lead segregated to the outer edge of the castings, ruining appearance, where this property is essential, and causing porous metal.

Aluminium as a deoxidiser should never be used in an alloy containing lead, as porosity is almost certain to occur, and if the alloy is to be used to withstand any internal air pressures, it would be disastrous.

Silicon in a brass containing lead should also never be considered as a deoxidiser. In fact, it should never be considered in any copper alloy where electrical conductivity is one of the properties desired.

CONTRACTS FOR 94 boilers required for various classes of saturated and superheated steam locomotives have recently been placed by the Union of South Africa Railways. Orders for 22 of these boilers have been placed with British firms, contracts for the remaining 72 having been awarded to Continental concerns. The allocation of the British orders is: North British Locomotive Company, Glasgow, Limited, ten boilers; Beyer Peacock & Company, Limited, Manchester, nine; Nasmyth Wilson & Company, Limited, Manchester, three. As regards the Continental orders, Werkspoor Engine Works, Amsterdam, are supplying 36 boilers; Maffei, Munich, 27; Krupps, Essen, seven; and Nicola-Romeo, Milan, two boilers. The Southern Railway Company have ordered 58 third-class motor coaches from the Metropolitan Carriage Wagon & Finance Company, Limited, Birmingham, and 29 first and third-class composite trailer-coaches from the Birmingham Railway Carriage & Wagon Company, Limited. Other contracts recently placed have been as follow:—Crown Agents for the Colonies: Eighteen 4-8-0 type locomotives (M.L.S. superheated), the Vulcan Foundry, Newton-le-Willows, Lancs.; 100 four-wheeled covered wagons and 100 four-wheeled low-sided goods wagons, Metropolitan Carriage Wagon & Finance Company, all for the Uganda Railways; five 2-8-2 type locomotives (Robinson superheated), Vulcan Foundry, for the Nigerian Railways; two 4-6-0 type locomotives (Robinson superheated), R. and W. Hawthorn Leslie & Company, Newcastle-on-Tyne, for the Ceylon Government Railways. Madras and Southern Mahratta Railway: Seven 2-6-4 type tank locomotives, Kerr Stuart & Company, Stoke-on-Trent, and 100 covered goods wagons and 100 open wagons for broad gauge lines, Metropolitan Carriage Wagon & Finance Company. Soudan Government Railways: Six "Prairie" type locomotives, Robert Stephenson & Company, Darlington.

Prejudice Against System.

By J. W.

"I don't think much of this system idea," said the manager of a fairly large factory. "We have a works organisation, of course, but it is pretty elastic, and we seem to get on very well without system, which, to my mind, is another word for 'red tape.'"

In a broad sense, the factory "seemed to be getting on very well without system," but as a matter of fact it was not doing well at all. The manager did not know this, but he did know that his running expenses were heavy, although he knew not the reason. He was "pulled up" periodically by his directors, and he carried on the good work by passing it on to his subordinate officials, which resulted in a drastic reduction of expenditure by means of a reduction of staff. This means, having satisfied the immediate requirement, a period of tranquillity followed, but it was of short duration, for the mere dismissal of men without increased activity in other directions simply means a reduction in output; and as this increased activity was possible only with the aid of "system" (which could not be tolerated) the only thing to do was to engage more men, until the original number was reached, and the output again reached its normal. Then followed (for the manager) another period of tranquillity, which was terminated only by another outburst on the part of the directors.

The cause of the trouble was obviously the appalling waste of time in the factory, which, owing to lack of system, was allowed to run on unchecked. There were too many operators, in relation to the output, and too few officials, in relation to the sation in the factory under review provided for the inspection of goods and material received from outside sources, but it failed to provide for the notifying of interested parties when the goods were rejected. In one instance a quantity of parts was ordered, and in due course came to hand. A receipt note reached the buyer, who, in the absence of further information, marked off his record and passed the invoice for payment. Some time afterwards, when the stock of the parts in question was well-nigh exhausted, the storekeeper asked the buyer to speed up further supplies, pointing out that a certain order was still incomplete. The buyer replied that this was not so, and gave particulars of the receipt note. As the parts could not be located, inquiries were instituted, and these elicited the fact that the parts in question had been received, but had been rejected by the inspector; and that the latter, acting upon the verbal instructions of the works manager, had forthwith turned them back on the supplier.

Many will no doubt protest that such a happening could not occur in any factory that had any system at all, but the fact is that the organisation was so elastic as to provide many loopholes. The manager's "Do this" was taken so literally that it did not occur to the subordinate officials to send out any notification, and in this particular instance the inspector, upon being told to return the parts to the supplier, did so without any regard to the consequences. Had a simple form, as illustrated by Fig. 1, been in operation, the matter could have been handled more expeditiously, and certainly more satisfactorily.

Lack of system can easily hold up the firm to ridicule in the eyes of those with whom it has dealings, and an instance may be quoted for the purpose of illustrating this point. In the factory

REJECTED.

From Inspection Dept. To { PURCHASING DEPARTMENT / PROGRESS DEPARTMENT } DATE .....

Please note that the following material, received from.....
against Purchasing Order No.....has failed to pass inspection, and should be returned to Suppliers.

PARTICULARS OF MATERIAL.	REASONS FOR REJECTION.

Signed ..... *Inspector.*

Confirmed ..... *Chief Inspector.*

FIG. 1.

many and varied duties they were obliged to perform. Had the aid of system been enlisted, there would have been quite sufficient officials, and without an increase in their number, for time would have been saved by the elimination of unnecessary duties, and the organisation of the necessary ones. On the other hand, there would not have been too many operators, yet none need be discharged, for their work would have been scientifically planned, and the result of this would have been increased productive value of every man, and a higher factory output.

It was easier for the manager to telephone an instruction to a subordinate than to commit it to paper, and so much quicker, too. It does not follow, however, that this method was always quicker in the long run, for mistakes were often made, which in some cases caused serious delay. In one case a client wished to have a modification embodied in the unit, and this was transmitted to the foreman concerned through the medium of the telephone. The foreman made a rough note of the requirement, which was mislaid soon afterwards and promptly forgotten by the foreman. The unit was erected to the standard specification, and as the inference contained in the instruction covered by the works order was that the unit was to be to the standard specification, it was passed by the inspector and despatched to the client, who promptly returned it with some very uncomplimentary remarks.

There is, perhaps, in some factories a needless amount of duplication in the matter of forms, but to avoid this there is nothing to be gained by rushing to the other extreme. The "elastic" organi- under review, there was a recognised receiving department, the understanding being that all goods received into the factory must in the first instance pass through this department, where the official receipt note was made out. As will have been noted by a previous statement, the receipt note was the buyer's intimation that the goods had been received, and until this note came to hand the order was regarded as incomplete.

In one case an order had been outstanding for quite a time, and although no speed-up had been sent from the works, the buyer wrote to the supplier and asked when the goods would be delivered. The reply was that the order had been completed some time previously, but the receiving department disclaimed all knowledge of receipt. After a good deal of time and trouble the missing goods were discovered actually in use. It transpired that the goods had arrived by post, and had been received by the works manager, who promptly discarded "time wasting" routine and took them to the department from which the requisition emanated.

These are by no means isolated cases, yet they show quite clearly the chaotic state of affairs which exist in the factory where system is discouraged. It is no doubt surprising to many to learn that in these enlightened days such a type of works manager is still in existence—the man who persists in clinging to old beliefs—who works by rule of thumb and abhors paper in any shape or form. And it is more than surprising that firms exist that permit this state of affairs to continue—the penny wise and pound foolish, who waste hundreds of pounds a year to save the little cost that an efficient system would entail.

Trade Talk.

J. STONE & COMPANY, LIMITED, contemplate additions to their works at Deptford.

THE Compañia Española de Mines del Riff reports for 1923 an iron-ore output of 365,333 tons.

TODMAN, RYALL & COMPANY, LIMITED, engineers, have moved to permanent offices at 125, High Holborn, London, W.C.1.

LICENCES HAVE BEEN GRANTED under the Non-Ferrous Metal Industry Act, 1918, to J. Forster & Company, 26, Great St. Helens, London, E.C.3, and C. J. Goldsmith, 91/93, Bishopsgate, London, E.C.2.

THE CLYDE CRANE & ENGINEERING COMPANY, LIMITED, have been successful in securing a contract for level luffing cranes for the Great Western Railway Company at Alexandra Dock, Newport.

A SHORT CONFIDENTIAL REPORT on the market for wrought-iron tubes and fittings in Uruguay has been prepared by the Department of Overseas Trade from information received from His Majesty's Consul-General at Montevideo.

JOSEPH KAYE & SONS, LIMITED, Lock Works, Leeds, have just received a new contract from the Admiralty for their patent seamless steel serrated valve oilfeeders. The oilfeeders in question are the type fitted with interchangeable spouts.

HARLAND & WOLFF, Belfast, have received an order from Andrew Weir & Company, London and Glasgow, for four twin-screw oil-carrying vessels, as a result of which the firm will re-open its south yard immediately. It has been closed for two years through depression.

THE REDBOURN HILL IRON & STEEL WORKS, Scunthorpe, have been closed down. A large proportion of the men engaged were paid off a month ago; the remainder have now been dismissed. The blast furnace at present in commission will be blown out this week. The work of installing new Coppee coke ovens is, however, proceeding.

THE MANCHESTER CORPORATION TRAMWAYS COMMITTEE has apportioned a contract for special track work between the United States Steel Products Company, 86, St. Vincent Street, Glasgow; Hadfields, Limited, Sheffield; Edgar Allen & Company, Limited, Imperial Steelworks, Sheffield; and the Titan Track Work Company, Limited, Rutland Road, Sheffield.

THE ELECTRIC FURNACE COMPANY, LIMITED, of 17, Victoria Street, London, S.W.1, have recently despatched a small Héroult electric furnace equipment to Lhassa, for the manufacture of steel castings. This equipment had to be specially manufactured in such a way that the weight of individual parts was within the limits necessary for animal transport over the Himalayas Mountains.

THE FELLOWSHIP OF THE BRITISH EMPIRE EXHIBITION, founded at the close of last year with the Prince of Wales as president, has now a group in every part of the Empire, but the subscription of two guineas necessarily limited the range of its appeal. It has been decided, with the approval of H.R.H. the Prince of Wales, to establish an associate branch with a subscription of five shillings.

THE ROYAL METAL TRADES' PENSION & BENEVOLENT SOCIETY is holding its eighth annual whist drive in aid of the funds of the Society, at the Finsbury Town Hall, Rosebery Avenue, E.C.1, on Saturday, November 1. The chairman and M.C. is Mr. Cecil Clayton (Brooks, Phillips & Company, Limited), Paddington Green, W.2. Tickets may be obtained from the chairman, members of the Auxiliary Committee, the stewards, or the secretary, at the offices of the Society, 195, Upper Thames Street, E.C.4. The Society is still in need of contributions in aid of the funds.

IT WAS GENERALLY anticipated that the Avonmouth Spelter Works would close down at the end of August, but fortunately this has been averted, at any rate for the time being. In consequence of the serious position, a deputation waited on the President of the Board of Trade, the Minister of Labour, and the National Spelter Company, in connection with the prospect of closing down. It is now reported that the notices have been withdrawn as a result of the representations made, and the employés have now been engaged on a day-to-day basis, pending further investigation of the position.

LORD DARYNGTON, speaking at the annual meeting of the Great Eastern Train Ferries, Limited, said that although up to the present the traffic from the Continent by the Harwich-Zeebrugge train ferry had been mainly fruit, cheese, and provisions, the company had now acquired wagons suitable for heavy ironwork, including boilers and large castings. It was proposed to develop these facilities which would be a considerable advantage to Leeds and Sheffield manufacturers. Heavy machinery ordered for long distance places such as Warsaw or Milan could be loaded up at the foundry and delivered in the same trucks at their destination.

Obituary.

MR. B. MILSOM, a director of John Williams & Sons (Cardiff), Limited, Globe Foundry, East Moors Road, Cardiff, died recently at the age of 50 years.

MR. JAMES LUMB, Copley Dene, Victoria Road, Elland, the founder of the firm of James Lumb & Sons, Limited, Perseverance Works, Dewsbury Road, Elland, died recently, aged 72 years.

MR. GEORGE HALL SCOTT, a director of, and for forty years one of the chief agents and engineers with, Sir John Jackson, Limited, died recently. Among the works carried out under his superintendence are the completion of the Manchester Ship Canal and the Admiralty Dockyard Extension at Keyham, Devonport; he received the Institution of Civil Engineers' prize for a paper on the latter work. He was also concerned with the construction of the railway from Arica, in Chile, to La Paz, in Bolivia, and a drydock and arsenal for the Spanish Government at Ferrol, Spain.

Personal.

MR. E. H. MURRANT and Mr. H. Smurthwaite have been elected directors of Furness, Withy & Company, Limited.

Wills.

ROBERTS, A., of Grammun Lodge, Edgerton, Huddersfield, brass founder £1,922

SCOTT, W., formerly chairman and joint managing director of the Dublin Dockyard Company, Limited £57,998

MILLS, W. F., of Barnsley Road, Sheffield, formerly manager of the engineering shop of Hadfields, Limited £4,747

HARGREAVES, COLONEL PERCY, chairman of Hick, Hargreaves & Company, Limited, Soho Ironworks, Crook Street, Bolton £88,016

JAEGER, W. R., of 6, Brondesbury Road, Kilburn, London, N.W., and of Middlesbrough, iron and steel merchant, head of Jaeger Brothers, Limited £11,034

NICHOLSON, R., of Newbould Lane, Sheffield, managing director of John Nicholson & Son (Sheffield), Limited, Mowbray Steel Works, Sheffield £41,687

Contracts Open.

Cowes, September 22.—174 yards of 10 in. cast-iron flanged pipes and 54 yards of 10 in. ditto S. and F. pipes, for the Urban District Council. Mr. J. W. Webster, surveyor and water engineer, Council Offices, Cowes, I.W.

Farnham, September 26.—Provision, laying and jointing of about 2,900 yards of 7 in., 6 in. and 5 in. cast-iron mains, together with valves and hydrants, and making connections to existing mains, for the Urban District Council. Messrs. John Taylor & Sons, 36, Victoria Street, Westminster, S.W.1. (Fee, £5, returnable.)

Great Yarmouth, September 19.—Castings, etc., for the Town Council. The Borough Engineer's Office.

Hull, September 22.—Cable and chain, etc., for the Humber Conservancy Board. Mr. A. W. Franklin, secretary, Conservancy Buildings, Hull.

Johannesburg, September 22.—Shovels, forks, picks, etc., for the South African Railways and Harbours. The Department of Overseas Trade.

Johannesburg, September 25.—9,950 ft. of 12 in. internal diameter water pipes, not less than ¼ in. thick, and various fittings, for the Municipal Council of Johannesburg. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Llangeinor, October 4.—Erection of 190 lineal yards of unclimbable wrought-iron fencing, for the Mid-Glamorgan Water Board. Messrs. Thomas & Morgan & Partners, engineers, 23, Gelliwastad Road, Pontypridd. (Fee, £2 2s.)

London, S.E., September 23.—Ironwork, for the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1.

London, S.E., September 23.—(2) Iron bars for Horsfall nutmaking machine, for the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1.

Stellenbosch, South Africa, September 26.—Cast-iron spigot and socket pipes, valves, etc., for the Municipality of Stellenbosch. The Department of Overseas Trade.

Wellington, N.Z., October 22.—Three electric capstans, etc., for the New Plymouth Harbour Board. The Department of Overseas Trade. (Deposit, £10.)

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The outlook in the Cleveland iron trade has, as yet, undergone no improvement in the depressed conditions prevailing of late, buying being still confined to minimum quantities in both home and export sections, while the impression is firmly held by consumers that even now the decline in prices has not reached the bottom level. The output of iron is now very restricted, but, happily, the Cleveland makers have not been saddled with big stocks, so that if a revival should come they will immediately feel the benefit, while the fact that so few of the inquiries from abroad produce any business would seem to indicate that Cleveland is not yet competing with Continental prices. Meanwhile, producers are picking up small orders at the best prices obtainable. It is rather a question of bargaining than of negotiating at fixed prices. Thus, although Cleveland makers are quoting 82s. 6d. per ton for the standard No. 3 G.M.B. foundry quality at this week's market, it was generally understood that anything more than a truck lot could be bought at 82s. No. 1 foundry iron, being rather scarce, was put at 87s. 6d., and No. 4 foundry and No. 4 forge at 81s. and 80s. per ton respectively.

In the Tees-side hematite section there is an utterly lifeless market, both for home consumption and for export. Last week the general market rate for East Coast mixed numbers was 90s. per ton and 90s. 6d. for No. 1, but here, again, the prospect of a good order would no doubt elicit some concession as to price. In the North-West area consumers are buying only for their immediate needs, so that prices are fairly well maintained. An order for anything like a substantial parcel would, of course, induce makers to make some concession. Bessemer mixed numbers are quoted at 103s. 6d. per ton delivered at Glasgow; 110s. per ton delivered at Sheffield; and 115s. per ton delivered at Birmingham.

LANCASHIRE.—The local market for foundry iron has again relapsed from its temporary activity, and business is dull and quiet, many of the larger buyers of foundry iron waiting to see what will happen in the Cleveland market. If that should show signs of recovery it is quite possible that the larger foundries here would begin to buy for their requirements over the remainder of the year; but if, on the contrary, Cleveland iron continues to sag they will wait. The usual price now quoted here for Derbyshire No. 3 foundry pig-iron is about 94s. per ton delivered, with some sellers taking 93s. 6d. and 93s.

THE MIDLANDS.—A little more interest has been evidenced of late by buyers in the foundry iron market, and Midland makers reported a fair volume of business passing, but this has since been reduced to quite modest proportions. There is still a lot of price-cutting, more especially amongst the Northants. makers, and it is reported that less than 82s. has been accepted for No. 3 iron. Current quotations now rule as follow:—Derbyshire No. 3 foundry, 85s. to 87s. 6d.; Staffordshire No. 3 foundry, 87s. 6d.; Northants. No. 3 foundry, 82s. 6d. to 85s.

SCOTLAND.—Not only is there no improvement in business here, but prices are, if possible, even easier than they have been. Scotch foundry iron remains nominally at 92s. 6d., but for a good line some concession can be obtained. There has been again some buying on the part of founders of late, and one or two quite large purchases have been made apparently by founders who are well off for pipe orders.

Finished Iron.

Trade in this branch of the industry continues to be restricted to a relatively small demand for high-quality material. The marked-bar houses are reported to be fairly busy on material for the engineering and wagon-building industries, but there is no real pressure for bar iron. The demand for crown iron remains very restricted—insufficient, in fact, to enable some of the idle works to be started again. Quotations for these qualities remain fairly firm, for one thing because no reduction that could be offered would be anything like sufficient to meet the competition which has displaced the material. The same is just as true of common bars and gas strip. Taken in the aggregate, the trade in rolled iron is insignificant in comparison with the productive capacity of the district, and there does not seem to be any chance of an adequate increase until it is possible (if ever) to make drastic reductions in the cost of production. Quotations:—Marked bars, £15 (net f.o.t. makers' works); crown bars, £13; nut and bolt bars, £12; gas strip £13 5s., all net delivered Birmingham area.

Steel.

Conditions in most branches of the steel industry continue disappointing, with acute foreign competition an additional factor in the prevailing general depression in the semi-product market. This material of Belgian, and now also German origin, is freely offered at £6 7s. 6d. delivered the Midlands, and naturally such a price commands the trade, which, by the way, remains comparatively restricted, although such a very large quantity of imported steel is being re-rolled. English makers are doing a moderate trade in carbon and special analysis steels, but little else. No further charge has been decided upon on ferro-manganese, which has steadied at the £13 10s. basis for the home trade, but for export the price remains nominal. In view of the advancing costs of production the Stabilisation (Prices) Committee have put up the minimum price of tinplates 6d. to 23s. 6d. basis I.C. f.o.b. Bristol Channel ports, and tinplate bars have also been advanced 3s. 6d. to £8 12s. 6d. f.o.b., less the usual rebate of 7s. 6d. to the tinworks in the prices agreement.

Scrap.

With demand on a minimum scale everywhere, reports from the various markets for scrap metal continue unsatisfactory, the conditions being mostly depressing and the outlook far from encouraging all round. In Lancashire the ironfoundry trade remains quiet, and rather lower prices have been reported lately for good cast scrap. There is an accumulation in the hands of dealers and the pressure to sell is growing. Some broken machinery make has been done at 82s. 6d., but most dealers are still trying to keep the price for this up to 85s. At the same time, common cast scrap can be bought at about 80s. per ton. In Scotland, machinery cast-iron scrap in pieces not exceeding 1 cwt. suitable for foundries is easier at 87s. 6d. to 90s. per ton, while ordinary cast-iron scrap to the same specification is 82s. 6d. to 83s. 6d. per ton, and for cast-iron scrap to steelworks' specification 82s. 6d. to 83s. 6d. per ton is quoted.

Metals.

Copper. — Following recent more unfavourable American advices, movements in standard copper have developed a weaker tendency in values, although downward fluctuations have, so far, been restricted within a narrow margin. The consumptive demand is still below expectations, and it now looks as if we shall have to await the placing of the international loan for Germany before any maintained upward movement in prices is likely to be established. Current quotations:—*Cash*: Thursday, £63; Friday, £63 2s. 6d.; Monday, £62 15s.; Tuesday, £62; Wednesday, £62 7s. 6d.

Three Months.—Thursday, £64 2s. 6d.; Friday, £64 2s. 6d.; Monday, £63 15s.; Tuesday, £63; Wednesday, £63 7s. 6d.

Tin.—The market for standard tin has also been going through a similar experience in a retrogression of values, due in this instance to a decline of consumption in the States, moderate buying on Continental account, and a less active demand for South Wales, where tinplate producers are mostly well covered for their requirements for some time to come. The American tinplate industry is at present only working about 50 per cent. capacity, but it is anticipated that this will shortly improve, as large foreign and domestic orders are expected to be placed. This should bring about a more extensive buying campaign for the metal, the majority of the American works having for some months past pursued a hand-to-mouth policy of tin purchasing. Current quotations: — *Cash*: Thursday, £252 7s. 6d.; Friday, £249 5s.; Monday, £240 15s.; Tuesday, £231 15s.; Wednesday, £231 15s.

Three Months.—Thursday, £254; Friday, £251; Monday, £242 15s.; Tuesday, £234; Wednesday, £234 15s.

Spelter.—Movements in this metal have been uneventful, with only a quiet demand. Messrs. Lazarus & Sons report that activity has only been fair, but the demand from galvanisers at home and in America has shown an improvement. Prices in the U.S.A. have been slightly raised, and the undertone of the London market is quite good. Current quotations:—*Ordinary*: Thursday, £33 2s. 6d.; Friday, £33 6s. 3d.; Monday, £33 7s. 6d.; Tuesday, £33 5s.; Wednesday, £32 17s. 6d.

Lead.—Reviewing the conditions of the market for soft foreign pig, Messrs. Lazarus write that demand continues excellent and, in spite of continued shipments to Europe from Mexico, everything points to the world's consumption taking care of supplies. The tendency of this market is strong and advancing, the final official quotation marking a rise on prompt shipment, while forward is unchanged. Current quotations:—*Soft foreign (prompt)*: Thursday, £33 6s. 3d.; Friday, £33 5s.; Monday, £33 2s. 6d.; Tuesday, £32 10s.; Wednesday, £32 13s. 9d.